Resistors
Capacitors
Trimmers
Selector Switches
Discrete Semiconductors

Surface Mount Device Catalog

Philips Components

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LEADED RESISTOR/CAPACITOR DATA BOOK contains important design, performance, and specifying data on leaded aluminum electrolytic capacitors, ceramic and tantalum capacitors, film and variable capacitors, fixed resistors, trimmers and nonlinear resistors.

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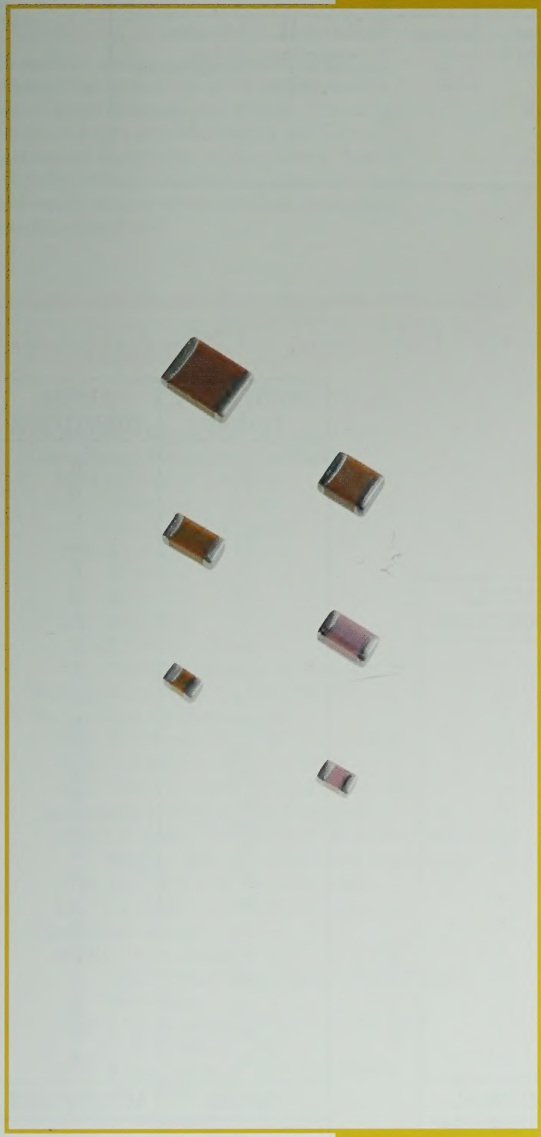
SERIES C • MONOLITHIC SMD® CHIP CAPACITORS



DESCRIPTION

■ The monolithic ceramic chip design provides state-of-the art volumetric efficiency in a capacitance device. Constructed from screening metal electrode material onto ceramic dielectric material with an inherent high K, alternating stacked layers are fired at a high temperature yielding a monolithic unit. Conductive metal alloy end terminations connect the alternating electrode layers to achieve a paralleling of the interleaved electrode plates and provide the means for electrical and mechanical contact within the circuit. Through this design of construction, the geometric factor is maximized by providing a large electrode area within a small housing unit.

■ Philips Components offers three types of dielectric material. NPO (COG)—CLASS I—is an ultrastable dielectric recognized by a zero TC slope. These capacitors sastisfy applications in which a specific capacitance value and a high Q (low dissipation factor) is critical for proper circuit performance. X7R and Z5U—CLASS II—are commonly referred to as stable and general purpose dielectrics, respectively. These capacitors exhibit a predictable change in capacitance over a specified operating temperature range. They are typically used in circuits for by-passing and decoupling applications.

■ In choosing the termination material, consideration should be given to the assembly process. Philips Components offers several termination options.

FEATURES

- Superior volumetric efficiency
- Adaptable to high speed automated mechanization assembly
- Excellent printed circuit board density as well as utilization of both board sides
- Capacitance range from 1 picofarad to 1.5 microfarad
- Voltage range from 25 to 200 volts
- Three standard dielectric material systems: NPO, X7R & Z5U
- Three standard terminations: Nickel Barrier, Tin/Lead; Nickel Barrier, 100% Tin; Palladium-Silver
- Components manufactured in a clean room environment using statistical and machine process control measures

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PART NUMBER DESIGNATION

C	XXX	X	XXXX	X	X	X	X
CHIP	CAPACITANCE: pF, two significant digits, third digit is a multiplier	TOLERANCE: C=.25 pf D=.5 pf F=1% G=2% J=5% K=10% M=20% Z=+80 −20%	CASE SIZE	TEMPERATURE CHARACTERISTIC: C=NPO X=X7R Z=Z5U	VOLTAGE: F=50 H=100 K=200	TERMINATIONS: P=Palladium-Silver N=Nickel, Tin L=Nickel, Tin/Lead	PACKAGING: B=Bulk T=Tape and Reel

MARKING

- An option of two marking systems is available to accommodate specific customer requirements.
- SINGLE CHARACTER ALPHANUMERIC COLOR CODE. The character designates two significant digits of capacitance, the color designates the multiplier of capacitance in picofarads.
- TWO CHARACTER CODE. The alpha identifier designates two significant digits of capacitance, the numeric identifier designates the multiplier of capacitance in picofarads.

"TWO CHARACTER MARKING"

SIGNIFICANT FIGURE	ALPHA IDENTIFIER	SIGNIFICANT FIGURE	ALPHA IDENTIFIER
1.0	A	4.7	S
1.1	B	5.1	T
1.2	C	5.6	U
1.3	D	6.2	V
1.5	E	6.8	W
1.6	F	7.5	X
1.8	G	8.2	Y
2.0	H	9.1	Z
2.2	J	2.5	a
2.4	K	3.5	b
2.7	L	4.0	d
3.0	M	4.5	e
3.3	N	5.0	m
3.6	P	6.0	n
3.9	Q	8.0	t
4.3	R	9.0	y

NUMERIC CHARACTER	DECIMAL MULTIPLIER	NUMBEIC CHARACTER	DECIMAL MULTIPLIER
0	10^0	5	10^5
1	10^1	6	10^6
2	10^2	7	10^7
3	10^3	8	10^8
4	10^4	9	10^{-1}

"SINGLE CHARACTER MARKING"

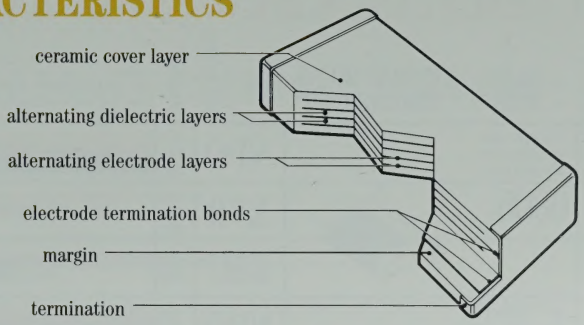
SIGNIFICANT FIGURE	ALPHA IDENTIFIER
10	A
11	B
12	C
13	D
15	E
16	H
18	I
20	J
22	K
24	L
27	N
30	O
33	R
36	S
39	T
43	V
47	W
51	X
56	Y
62	Z
68	3
75	4
82	7
91	9

COLOR	MULTIPLIER
ORANGE	10^{-1}
BLACK	10^0
GREEN	10^1
BLUE	10^2
VIOLET	10^3
RED	10^4

CONSTRUCTION and CHARACTERISTICS

MONOLITHIC CONSTRUCTION

Monolithic ceramic capacitors consist of alternating ceramic (15 to 30 microns) onto which metal electrodes are printed. The stacked layers, cut into individual chips, are then sintered at a very high temperature to form a monolithic device. Alternating electrode layers are connected to end terminations completing the functional unit.



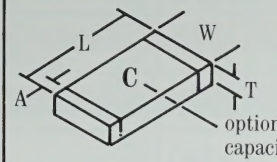
GENERAL SPECIFICATIONS

ELECTRICAL PARAMETERS

Capacitance Range: 1 pF through 1.5μF
Capacitance Tolerance: (Standard)
NPO: C=0.25 pf G=2%
D=0.5 pf J=5%
F=1% K=10%
X7R: J =±5%
K=±10%
M=±20%
Z5U: M=±20%
Z =+80 −20%
P =GMV (Guaranteed Minimum Value)
Working Voltage: 25, 50, 100, 200 VDC
Temperature Characteristics:
NPO: 0 ±30 ppm/°C, −55°C to +125°C
X7R: ±15% ΔC, −55° to +125°C
Z5U: +22% to −56% ΔC, +10°C to +85°C
Capacitance test @ 25°C or referenced to 25°C:
NPO: 1.0 VRMS ±.25 VRMS @ 1kHz for values above 100pF, 1 MHz for 1000pF and lower values.
X7R: 1.0 VRMS ±.25 VRMS @ 1kHz.
Z5U: 0.5 VRMS ±0.1 VRMS @ 1kHz.
Dissipation Factor:
NPO: 0.1% maximum @ 25°C, 1.0 VRMS ±.25 VRMS @ 1kHz., 1 MHz for 1000pF and lower value.
X7R: 2.5% maximum @ 25°C, 1.0 VRMS ±.25 VRMS @ 1kHz.
Z5U: 3% maximum @ 25°C, 0.5 VRMS ±0.1 VRMS @ 1kHz.
Insulation Resistance:
100K megohms or 1000 megohm microfarads, whichever is less at 25°C. Measured after 2 min. with 50 mA limiting current.
Dieletric Strength:
NPO, X7R, Z5U: 250% rated voltage with 50 mA maximum charging current.

MECHANICAL PARAMETER

INCH (MILLIMETER)



CASE SIZE CHART

EIA Size Code	L	W	T Max.	A Min./Max.
0805	.079±.008 (2.03±0.20)	.049±.008 (1.25±0.20)	.050 (1.27)	.010/.030 (0.25/0.76)
1206	.126±.008 (3.20±0.20)	.063±.008 (1.60±0.20)	.059 (1.25)	.010/.030 (0.25/0.76)
1210	.126±.008 (3.20±0.20)	.098±.008 (2.51±0.20)	.065 (1.65)	.010/.035 (0.25/0.89)
1812	.177±.012 (4.54±0.30)	.126±.008 (3.20±0.20)	.065 (1.65)	.010/.035 (0.25/0.89)
1808	.180±.015 (4.57±0.38)	.080±.015 (2.03±0.38)	.065 (1.65)	.010/.035 (0.25/0.89)
1825	.177±.012 (4.54±0.30)	.252±.016 (6.46±.040)	.065 (1.65)	.010/.035 (0.25/0.89)
2218	.225±.020 (5.72±0.51)	.175±.015 (4.45±0.38)	.070 (1.78)	.015/.040 (0.38/1.02)

TERMINATIONS AVAILABLE

Palladium−Silver
Nickel Barrier, 100% Tin
Nickel Barrier, Tin/Lead

CAPACITANCE RANGES AVAILABLE BY SIZE

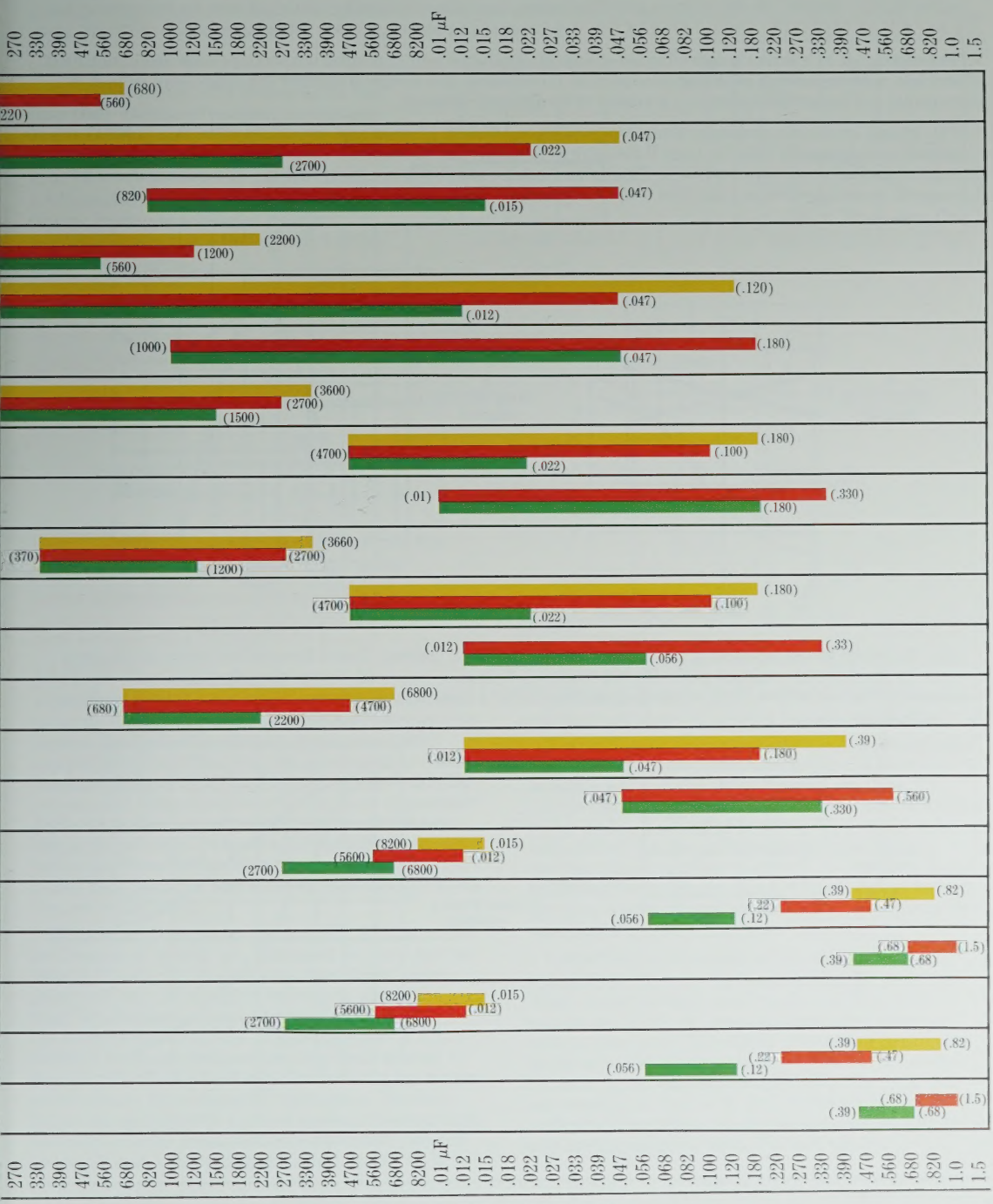
CASE SIZE	GEOMETRICAL DIMENSIONS	DIELECTRIC	VOLTAGE
0805	L =.079±.008 W=.049±.008 T =.050 MAX	NPO	50 100 200
		X7R	50 100 200
		Z5U	50 100
1206	L =.126±.008 W=.063±.008 T =.050 MAX	NPO	50 100 200
		X7R	50 100 200
		Z5U	50 100
1210	L =.126±.008 W=.098±.008 T =.065 MAX	NPO	50 100 200
		X7R	50 100 200
		Z5U	50 100
1808	L =.180±.015 W=.080±.015 T =.065 MAX	NPO	50 100 200
		X7R	50 100 200
		Z5U	50 100
1812	L =.177±.012 W=.126±.008 T =.065 MAX	NPO	50 100 200
		X7R	50 100 200
		Z5U	50 100
1825	L =.177±.012 W=.252±.016 T =.065 MAX	NPO	50 100 200
		X7R	50 100 200
		Z5U	50 100
2218	L =.225±.020 W=.175±.015 T =.070 MAX	NPO	50 100 200
		X7R	50 100 200
		Z5U	50 100

1.0 pF 1.2 1.5 1.8 2.2 2.7 3.3 3.9 4.9 5.6 6.8 8.2 10 12 15 18 22 27 33 39 47 56 68 82 100 120 150

(120)

DIELECTRIC / VOLTAGE — 1.0 pF 1.2 1.5 1.8 2.2 2.7 3.3 3.9 4.9 5.6 6.8 8.2 10 12 15 18 22 27 33 39 47 56 68 82 100 120 150

NOTE: SIZES SHOWN ARE EIA STANDARD SIZES.



PLEASE CONTACT FACTORY FOR OTHER AVAILABLE SIZES.

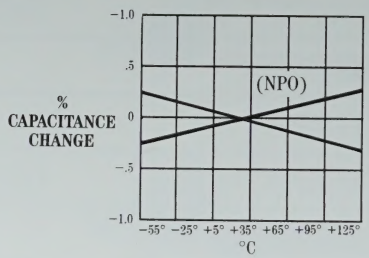
DIELECTRIC CHARACTERISTICS

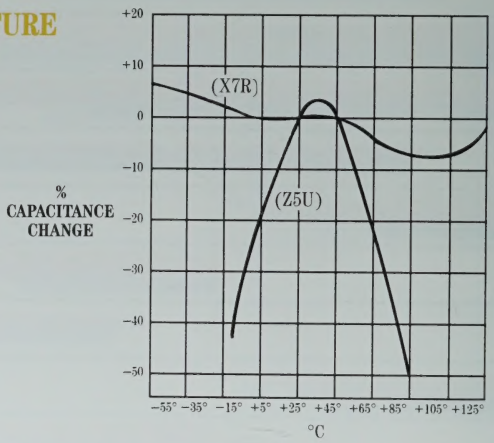
TEMPERATURE CHARACTERISTICS

■ The temperature co-efficient is defined as the change in capacitance over a specified temperature range and is measured at zero bias, with the amount of change relative to 25°C conditions. The electrical stability of a component, defined by temperature and voltage characteristics, is related to its dielectric constant.

■ NPO—a Class I dielectric—possesses a zero temperature co-efficient, allowing superior stability. The TC of a NPO component is expressed in PPM/°C. Class II dielectrics—X7R, Z5U—are ferroelectric ceramics and while the dielectric constant of these materials are superior to Class I, the electrical stability is nonlinear with the TC being expressed as % change in capacitance across a specified temperature range.

CAPACITANCE CHANGE VS. TEMPERATURE

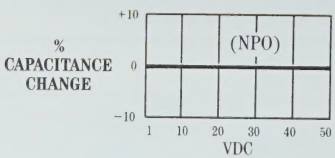


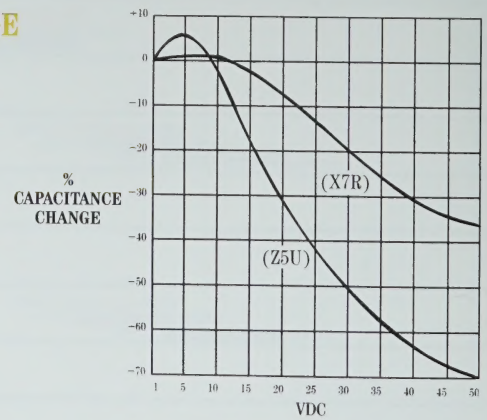


VOLTAGE

■ Class I dielectrics are not significantly affected by increases in voltage; however, Class II ferroelectric dielectrics display a decrease in the dielectric constant as the DC bias increases. With increases in DC voltage the polarization cycle which acts to oppose DC bias is inhibited. Thus, a high K dielectric exhibits a reduced dielectric co-efficient when subject to strong DC electric fields.

CAPACITANCE CHANGE VS. DC VOLTAGE





DISSIPATION FACTOR (DF)

The dissipation factor is the ratio of resistance to reactance used as a measure of dielectric loss resulting from continual reversing of the polarity of the electric field. These "relaxation losses" occur when the molecular structure must adjust to a new polarity and are manifested through heat dissipation and a measurable deviance from the 90° current–voltage phase angle. The DF is frequency sensitive and is expressed as a percentage.

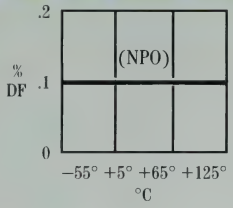
QUALITY FACTOR (Q)

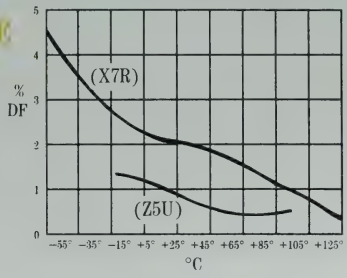
The Quality Factor is the inverse of the loss factor (DF)—the ratio of reactance to resistance. Quality Factor is also frequency dependent.

INSULATION RESISTANCE

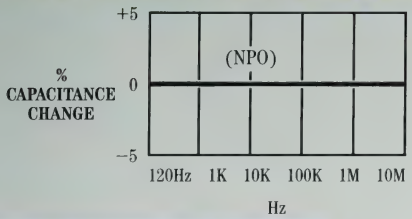
All capacitors have a small amount of leakage current. Insulation resistance, usually measured in megohms is the capacitor's ability to block this current.

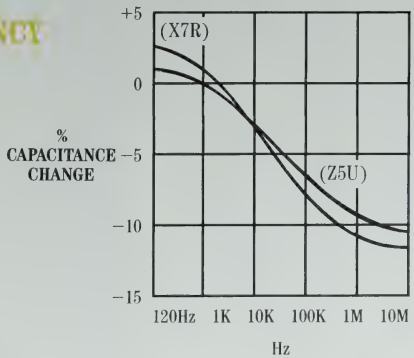
DF VS. TEMPERATURE





CAPACITANCE CHANGE VS. FREQUENCY





APPLICATION NOTES

PAD DESIGN

Successful ceramic chip attachment to a circuit board/substrate is relative to specific mechanical considerations. Because the thermal co-efficient of expansion of the ceramic dielectric differs from that of epoxy glass circuit board and alumina substrate, the pad design and soldering process must compromise the effects of sharp temperature gradients imposed on the assembled units. Recommendations for pad design are based on two soldering processes—Reflow and Wave. Reflow soldering employs solder paste coated pads; whereas, Wave relies on glue attachment of the chip to the board.

REFLOW METHOD. Using this process, the dimensions are determined by chip size, placement accuracy and the amount of solder for an acceptable fillet. Dried solder paste coats the pad and holds the chip in place. Chip to board attachment is achieved by remelting and reflowing the solder. Alignment of the chip during reflow is accommodated by the pad design as the chip tends to move in response to surface tension forces generated by the molten solder wetting the termination metalization. The reflow process should begin with a gradual heating of the board and components to the solder melting temperature (approximately 2°C/sec.), followed by continued heating to 30° above that temperature for 10 to 20 seconds. The assembly may then cool slowly in ambient temperature (25°C).

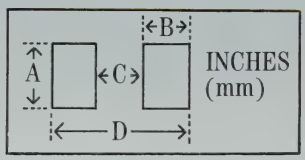
WAVE METHOD. This process involves glue attachment of the component to the board. After preheating the assembly to within 100°C of the solder temperature, (typically 220° to 250°C), the board is immersed in a wave of molten solder for 3 to 5 seconds. The solder fillet size must be contained so that the solder bond strength does not overcome the chips inherent strength. This can be achieved by limiting the pad size so that is does not extend beyond the chips terminations. A hot air-knife following the solder wave may also reduce fillet size.

TOMBSTONE or DRAWBRIDGING results when both terminations are not wetted equally or at the same time. When one termination wets first the resulting surface tension acts to lift the opposing termination while the molten solder at the non-wetted termination contributes to this action by allowing the end to float. In the second instance, a chip misplaced lengthwise on the pads, with one termination close to or over the edge of its pad, even with both terminations equally wetted, with no fillet to hold the opposing end down, that end will lift.

■ THERMAL SHOCK. Due to the differences in the thermal co-efficient of expansion of the ceramic chip and circuit board/substrate, significant mechanical stress is generated in the solder attachment process. Thus, controlling the rate of temperature change to provide even heating is essential to the process.

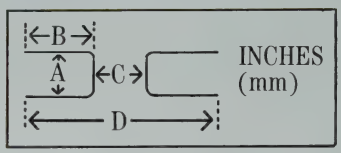
■ LEACH RESISTANCE. Leaching involves a dissolution of termination silver resulting from exposure to molten solder, which may destroy the metalization of its attachment to the ceramic body. Thus, the total time of chip exposure to molten solder must be controlled to avoid mechanical or electrical damage. Terminations with Nickel Barrier plated over the silver alloy will significantly extend the time a chip can withstand exposure to heat.

RECOMMENDED PAD DIMENSIONS FOR REFLOW METHOD



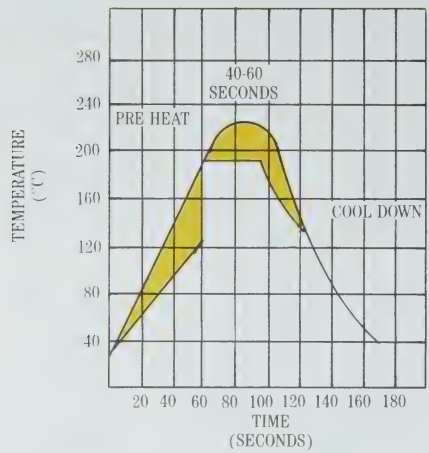
CHIP SIZE	A MIN.	B MIN.	C NOM.	D NOM.
0805	.080 (2.0)	.050 (1.25)	.030 (0.75)	.130 (3.3)
1206	.090 (2.3)	.050 (1.25)	.075 (1.9)	.175 (4.45)
1210	.130 (3.3)	.050 (1.25)	.075 (1.9)	.175 (4.45)
1812	.160 (4.1)	.060 (1.5)	.120 (3.0)	.240 (6.1)
1825	.285 (7.2)	.060 (1.5)	.120 (3.0)	.240 (6.1)

RECOMMENDED PAD DIMENSIONS FOR WAVE METHOD

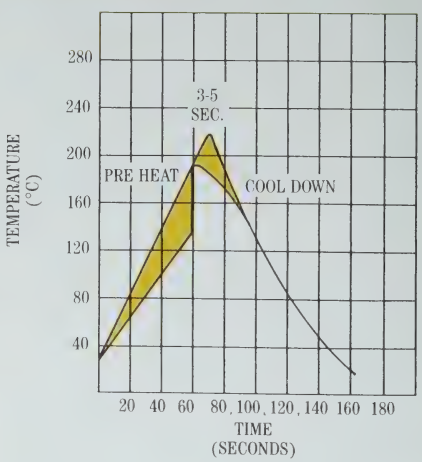


CHIP SIZE	A	B	C NOM.	D
0805	.035/.050 (.89/1.25)	.050/.065 (1.25/1.65)	.030 (.75)	.130/.160 (3.3/4.1)
1206	.035/.050 (.89/1.25)	.050/.065 (1.25/1.65)	.075 (1.9)	.175/.205 (4.45/5.2)
1210	.060/.100 (1.5/2.5)	.050/.065 (1.25/1.65)	.075 (1.9)	.175/.205 (4.45/5.2)
1812	.075/.100 (1.9/2.5)	.060/.075 (1.5/1.9)	.120 (3.0)	.240/.270 (6.1/6.9)
1825	.2/.265 (5.1/6.7)	.060/.075 (1.5/1.9)	.120 (3.0)	.240/.270 (6.1/6.9)

RECOMMENDED PROFILE FOR REFLOW METHOD



RECOMMENDED PROFILE FOR WAVE METHOD



NOTE:
For tape and reel specifications, turn to the packaging information section at the back of this catalog.

SERIES 49BC BLUE CHIP Tantalum SMD® (Chip) Capacitors

DESCRIPTION

■ The 49BC BLUE CHIP Series is the original conformally coated Chip Tantalum Capacitor developed and patented in the early 1970's.

■ Electronic applications had evolved tighter and tighter requirements which demanded more reliable components with longer life, lower electrical losses and more volumetric efficiency due to the constraints of smaller and smaller circuitry.

■ The BLUE CHIP capacitor was developed to fill those needs. It combined the long life and high reliability of a tantalum capacitor with the desirable design elements of a chip component. Low ESR, low DC leakage, low inductance and maximum volumetric efficiency are hallmarks of the BLUE CHIP capacitor's design and construction.

■ The BLUE CHIP utilizes a high CV, sintered tantalum anode and a solid electrolyte to achieve its small size. It is conformally coated with the patented Blue Seal process. The fluoropolymer/fluoroelastomer coating provides protection to the internal capacitive element while remaining flexible enough to withstand thermal stresses and adding a minimum to the overall size of the capacitor. Ruggedized terminal construction provides a margin of reliability not found in other styles.

■ The BLUE CHIP has become the unquestioned industry standard of reliability in circuit assembly and performance. The product has been customer tested and proven—over 400 million unit user test hours—in a broad range of circuit applications under severe environmental and electrical stress conditions. The CWR06 style BLUE CHIP is available in both military established reliability—Exponential Failure Rate Levels (M, P, and R) and Weibull Graded Failure Rate Levels (B, C, and D), per MIL-C-55365/4B.

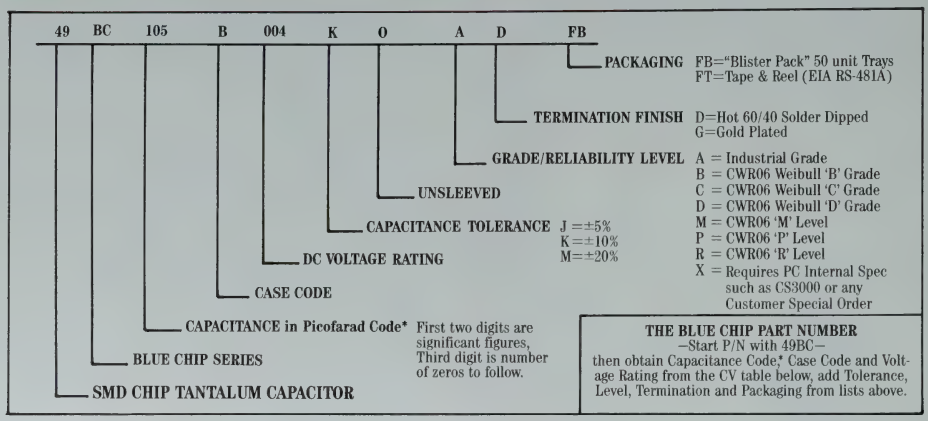
■ Philips Components manufactures the BLUE CHIP products utilizing advanced Statistical Process Control methods (SPC). The use of Statistical Process Control techniques provides a very consistent and reliable product.

FEATURES

- −55°C through 85°C Operation (125°C with Voltage Derating)
- Capacitance Range: 0.1μF to 100 μF
- Rated Voltages: 4 VDC to 50 VDC
- Qualification to MIL-C-55365/4B Style CWR06 Exponential Failure Rate Levels M, P, and R and Weibull Graded Failure Rate Levels B, C, and D
- 8 Case Sizes from .050″ x .050″ x .100″ To .110″ x .150″ x .285″
- Low ESR in High-Frequency Applications
- Gold Plated or Solder Dipped Terminations
- Conformally Coated Construction Provides Maximum Volumetric Efficiency (100,000 μFV/Cubic Inch)
- Tape & Reel Packaging Available in 8 & 12 mm Tape Widths

®SMD is a Service Mark of North American Philips Corporation
®BLUE CHIP is a Registered Trade Mark. The Blue Chip is patented under US Patent No. 3,855,505

PART NUMBER DESIGNATION


49 BC 105 B 004 K 0 A D FB
PACKAGING FB="Blister Pack" 50 unit Trays FT=Tape & Reel (EIA RS-481A)
TERMINATION FINISH D=Hot 60/40 Solder Dipped G=Gold Plated
GRADE/RELIABILITY LEVEL A = Industrial Grade B = CWR06 Weibull 'B' Grade C = CWR06 Weibull 'C' Grade D = CWR06 Weibull 'D' Grade M = CWR06 'M' Level P = CWR06 'P' Level R = CWR06 'R' Level X = Requires PC Internal Spec such as CS3000 or any Customer Special Order
UNSLEEVED
CAPACITANCE TOLERANCE J = ±5% K = ±10% M = ±20%
DC VOLTAGE RATING
CASE CODE
CAPACITANCE in Picofarad Code* First two digits are significant figures, Third digit is number of zeros to follow.
BLUE CHIP SERIES
SMD CHIP TANTALUM CAPACITOR
THE BLUE CHIP PART NUMBER
—Start P/N with 49BC—
then obtain Capacitance Code,* Case Code and Voltage Rating from the CV table below, add Tolerance, Level, Termination and Packaging from lists above.

49BC CAPACITANCE—VOLTAGE—CASE CODE TABLE

■ Select standard Capacitance/Voltage ratings and corresponding standard Blue Chip case codes from this table. If you require a capacitance/voltage that is not listed as a standard value, please call us. We may already be building it as a special.

CAP µF	PICOFARAD CODE*	004 V	006 V	010 V	015 V	020 V	025 V	035 V	050 V
0.10	104	B	B	B	B	B	B	B	B
0.15	154	B	B	B	B	B	B	B	B
0.22	224	B	B	B	B	B	B	B	L
0.33	334	B	B	B	B	B	B	L	L
0.47	474	B	B	B	B	B	L	L	U
0.68	684	B	B	B	B	L	L	U	E
1.0	105	B	B	B	L	L	U	E	C
1.5	155	B	B	L	L	U	E	C	H
2.2	225	B	L	L	U	E	C	H	H
3.3	335	L	L	U	E	C	H	H	I
4.7	475	L	U	E	C	H	H	I	P
6.8	685	U	E	C	H	H	I	P	—
10.0	106	E	C	H	H	I	I	—	—
15.0	156	C	H	H	I	I	P	—	—
22.0	226	H	H	I	I	P	—	—	—
33.0	336	H	I	I	P	—	—	—	—
47.0	476	I	I	P	—	—	—	—	—
68.0	686	I	P	—	—	—	—	—	—
100.0	107	P	—	—	—	—	—	—	—

PHYSICAL SPECIFICATIONS

DIMENSIONS—Inches

CASE CODE		(W) WIDTH ±0.015	(L) LENGTH ±0.015	(H) HEIGHT ±0.015	(S) SPACING Typical	(B) PAD WIDTH ±0.005
49BC	CWR06					
B	A	.050	.100	.050	.040	.030
L	B	.050	.150	.050	.090	.030
U	C	.050	.200	.050	.140	.030
E	D	.100	.150	.050	.090	.030
C	E	.100	.200	.050	.140	.030
H	F	.135	.220	.070	.160	.030
I	G	.110	.265	.110	.165	.050
P	H	.150	.285	.110	.185	.050

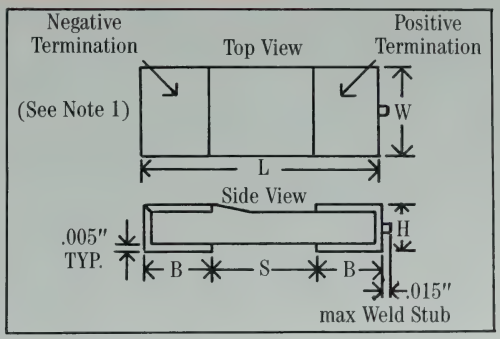
DIMENSIONS—mm

CASE CODE		(W) WIDTH ±0.381	(L) LENGTH ±0.381	(H) HEIGHT ±0.381	(S) SPACING Typical	(B) PAD WIDTH ±0.127
49BC	CWR06					
B	A	1.27	2.54	1.27	1.02	0.76
L	B	1.27	3.81	1.27	2.29	0.76
U	C	1.27	5.08	1.27	3.55	0.76
E	D	2.54	3.81	1.27	2.29	0.76
C	E	2.54	5.08	1.27	3.55	0.76
H	F	3.43	5.59	1.78	4.06	0.76
I	G	2.79	6.73	2.79	4.19	1.27
P	H	3.81	7.25	2.79	4.70	1.27

NOTES:

1. For polarity identification, when chip is in mounting position, bare metal clip and weld stub are positive. The top surface of the negative terminal is blue.
2. Metric Equivalents are for general information purposes only and are based on 1″=25.4 mm.
3. Anode Riser (Weld Stub) may extend case size Length dimension by 0.015″ (.38 mm) max.

CASE OUTLINE DRAWING

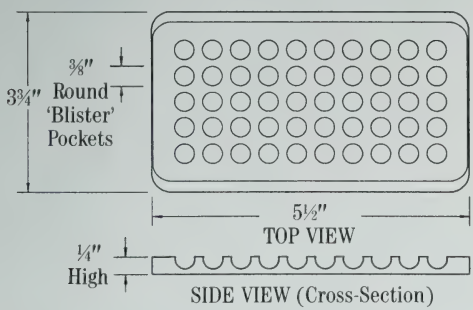


4. Dimensions given are for gold-plated terminations. For solder-dipped terminations, add +0.015″ (.38 mm) to dimension tolerances.
5. Spacing dimension is typical distance between chip mounting terminations and therefore average distance between mounting pads on substrate.

PACKAGING

BLISTER-PACK TRAYS

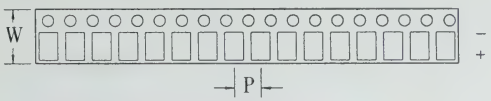
■ 49BC Series capacitors are shipped in 'Blister Pack' trays containing 50 pieces each in a 5 x 10 matrix configuration. The Blister Pack provides a separate pocket for each unit to prevent damage to the capacitors during shipping, handling and storage.



■ Blister Pack trays are stamped polystyrene with a clear plastic cover. Orientation of the capacitors within the pockets is random with respect to polarity and mounting surface. This packaging is ideal for hand placement of the capacitors as it takes up very little room at a work station. It is recommended that operators remove and work with the BLUE CHIPs using a blunt, coated tweezer to prevent damage to the Blue Seal conformal coating.

TAPE & REEL

■ 49BC Series capacitors are available in Tape & Reel packaging to facilitate the use of automatic placement equipment. Tape & Reel is per EIA (Electronic Industries Association) specification RS-481A. Capacitor orientation within tape pockets is negative terminal toward sprocket holes and mounting side down. 8 and 12 mm tape widths are used according to case size. Quantities less than minimum reel will be shipped in Blister Pack trays.



TAPE & REEL SPECIFICATIONS

49BC Case Code	CWR06 Case Code	(W) Tape Width	(P) Unit Pitch Ctr/Ctr	Quantity per full 7″ Reel	Minimum Quantity per Reel
B	A	8 mm	4 mm	3,000	1,500
L	B	12 mm	4 mm	3,000	1,500
U	C	12 mm	4 mm	3,000	1,500
E	D	12 mm	4 mm	2,700	1,350
C	E	12 mm	4 mm	2,700	1,350
H	F	12 mm	8 mm	1,000	500
I	G	12 mm	8 mm	700	350
P	H	12 mm	8 mm	700	350

BLUE CHIP CHARACTERISTICS

■ From the least expensive BLUE CHIP, the 49BC Industrial Grade, to the Established Reliability CWR06 'R' Level chips, all members of the BLUE CHIP Family of capacitors share many of the same attributes and characteristics. All BLUE CHIP capacitors share the same design and construction and utilize the same materials and manufacturing processes. The main distinction between the different grades is typically the conditioning of the capacitor, test sequences used and the acceptance criteria that apply.

■ Features and characteristics common to all grades are listed here, and differences between the grades are pointed out on the facing page in a specific discussion about each of the family members.

DESIGN and CONSTRUCTION

■ Each BLUE CHIP capacitor consists of a highly purified sintered tantalum anode body utilizing an electrolitically formed (tantalum pentoxide) dielectric and a solid (manganese dioxide) electrolyte. The shock & vibration resistant solderable terminals are attached to the capacitor body which is then protected against normal electronic equipment environments by Philips Components proprietary Blue Seal process.

■ The Blue Seal process completely insulates the BLUE CHIP from the circuit. No additional insulation need be specified. Only the mounting terminals are exposed. The terminals are made of 0.005" thick type N1 nickel that is plated with 100 micro inches of gold or hot solder dipped with 60/40 tin/lead solder. The terminals are specifically designed for all standard mounting techniques. All terminal materials meet the requirements of MIL-STD-1276 and MIL-G-45204.

MARKING

■ The small physical size of the BLUE CHIP does not permit alphanumeric marking on the body of the capacitor. Color dots on the body of the capacitor are available on special order. Series 49BC capacitors are identified on their container package.

SURFACE MOUNT APPLICATION

■ BLUE CHIP capacitors are ideally suited for use on SMT circuit boards where circuit density requires the use of components with the highest cap/unit volume efficiency. The compliant body coating permits conductive lines to be run underneath the body of the capacitor for maximum circuit density.

■ Current solder reflow techniques such as Belt Reflow, IR (Infra-Red), Wave Soldering and Vapor Phase may be utilized with these capacitors. The BLUE CHIP's unique construction enables it to withstand soldering temperatures for longer durations than other types of tantalum chip construction. Multiple reflows may be made with no degradation to the capacitor's physical or electrical characteristics.

■ All substrate materials and all common cleaning solvents used in the industry are compatible with the BLUE CHIP. Automatic placement equipment may be used by specifying Tape & Reel packaging.

CAPACITANCE—DISSIPATION FACTOR—DC LEAKAGE

■ Capacitance shall be measured at or referred to 120 Hz at 25°C. Maximum DC bias is 2.2 V. AC signal shall not exceed 1.0 VRMS.

■ Tolerance—available in 20%, 10% and 5% cap tolerances. Other tolerances are available under 'Customer Specials.'

−55°C	+85°C	125°C
−10% Δ	+10% Δ	+15% Δ

Capacitance Change with Temperature from 25°C readings (maximum change)

■ Dissipation Factor—Limits for DF are specified under Industrial Grade or CWR06. Refer to specific DF tables.

■ DC Leakage—Limits for DCL are specified under Industrial Grade or CWR06. Refer to specific DCL tables.

■ DCL shall be measured at WVDC after a 5 minute electrification period with a 1000 ohm current limiting resistor in series.

VOLTAGE RATING

■ All BLUE CHIPS can be used at elevated temperatures when the working voltage is derated in accordance with the following table:

Rated WVDC −55°C to 85°C	Derated (DC) 125°C	Surge Voltage (DC) 85°C	Surge Voltage (DC) 125°C
4	2.7	5.0	3.2
6	4.0	8.0	4.8
10	7.0	13.0	8.0
15	10.0	20.0	12.0
20	13.0	26.0	18.0
25	17.0	32.0	20.0
35	23.0	46.0	28.0
50	33.0	65.0	40.0

■ The surge voltage is the maximum DC voltage, including AC or other pulses applied for short duration.

REVERSE VOLTAGE

■ Series 49BC BLUE CHIP capacitors will withstand momentary voltage reversals up to 15% of their rated voltage at 25°C, 10% at 55°C, 5% at 85°C and 1% at 125°C.

POLARITY

■ Series 49BC capacitors are polar devices intended for applications involving D.C. circuits. Proper polarity must be observed or damage to the capacitor and/or the circuit will result. Polarity is indicated when looking at the non-mounting (top) surface by the bare metal terminal on the positive end and the Blue Seal covered terminal on the negative end.

AC POWER DISSIPATION

CASE CODE	MAXIMUM POWER DISSIPATION IN WATTS AMBIENT TEMPERATURE		
	25°C	85°C	125°C
B	.063	.056	.025
L	.075	.067	.030
U	.081	.073	.032
E	.095	.085	.038
C	.100	.090	.040
H	.125	.112	.050
I	.150	.135	.060
P	.200	.180	.080

■ Major physical factors which limit the ability of the capacitor to dissipate internally generated heat produced during AC circuit operation, include unit construction features as related to a particular capacitor design, and heat transfer characteristics of the materials used in the construction of the capacitor. Larger volumetric packages exhibiting electrical characteristics similar to those of smaller physical packages will, under similar conditions, be capable of dissipating more power. Conformally coated capacitors, such as the Blue Chip series, exhibit more efficient heat dissipation capabilities, due to the absence of relatively thick thermally insulative coatings, as incorporated in "molded" tantalum chip capacitor styles.

■ Maximum power dissipation levels shown represent an empirically determined wattage level required to cause a 10 degree centigrade temperature increase above the stated temperature in "still air" as measured on the external capacitor body, utilizing a thermo-couple or other appropriate measuring device.

AC RIPPLE CURRENT

■ Circuit design and physical layout should provide "cool" circuit board locations for capacitors operating at high AC current levels. Capacitor temperature may increase due to heat transfer/absorption from the ambient environment or a "hot" component mounted in close proximity to the capacitor. The result of increased AC current is increased internal heat generation within the capacitor body. Waveform envelope is also a factor in the amount of internal heat generated within the capacitor since non-sinusoidal waveshapes produce heating effects different than those of sinusoidal waveforms.

■ The ripple current and voltage level impressed across the capacitor should not exceed the maximum power dissipation of the capacitor unless special provisions are made to increase the rate of heat dissipation from the body of the capacitor, such as by the use of a heat sink or providing air flow. Excessive power dissipation in tantalum chip capacitors may cause catastrophic failure. The I_{max} value of current must be used to determine the operating conditions.

■ The maximum permissible AC (rms) current applied across the capacitor is related to the equivalent series resistance (ESR) and the physical power dissipation capability of the capacitor. The maximum (rms) ripple current at a given frequency may be determined by:

$$I_{max}(rms) = \sqrt{Pdm/ESR}$$

where...Pdm = Maximum Power Dissipation in watts, at the maximum circuit operating temperature

$$ESR = \frac{1}{2\pi * AC\ Frequency * Capacitance} * D.F.$$

AC Frequency is in Hertz
Capacitance is in Farads
Dissipation Factor is in decimal form

AC RIPPLE VOLTAGE

■ The maximum AC ripple voltage at the applied frequency must be limited to an rms value which permits only the recommended maximum power dissipation specified for a given case code.

■ The maximum AC ripple voltage may be determined by:

$$E_r(rms) = Z\sqrt{Pdm/ESR}$$

where...E_r = AC Ripple Voltage
Z is the Impedance in ohms
Pdm is the Maximum Power Dissipation in watts, at the maximum circuit operating temperature
ESR is the Equivalent Series Resistance in ohms

■ Both voltage and current levels at a given frequency must be maintained so as not to exceed the recommended maximum power dissipation levels at the maximum circuit operating temperature. The DC bias voltage applied in series with the AC source applied across polar style capacitors, on which the AC voltage is "riding," may be ignored when considering the heating effects of AC current on the capacitor. The positive peak AC voltage plus the DC voltage must not exceed the rated DC voltage of the capacitor. The negative peak AC voltage in combination with the DC voltage may not obtain a level which will damage the dielectric due to reverse voltage being applied across a polar solid electrolyte tantalum chip capacitor.

CONDITIONING

■ All BLUE CHIP capacitors are given a 100% low impedance power burn-in at 85°C prior to shipment to improve performance in low impedance circuits where high current surges may occur in the capacitor.

THE BLUE CHIP FAMILY

49BC INDUSTRIAL GRADE

■ The presence of an 'A' in the 14th position of the BLUE CHIP part number specifies an Industrial Grade capacitor. While sharing many of the characteristics of its high reliability counterparts, the conditioning of the Industrial Grade BLUE CHIP is not as extensive. Electrical limits for Industrial Grade are listed in the table below.

CS3000 HIGH RELIABILITY

■ The CS3000 High Reliability BLUE CHIP originated as a Customer Special in the mid 1970's. This variation on the Blue Chip series was developed to satisfy requirements of battery operated circuits for a capacitor that was small in size, low in DC leakage and would provide extended long term life.

■ The CS3000 is specially processed and conditioned to retain its ultra low leakage characteristics through all subsequent hybrid manufacturing processes and conditioning sequences.

■ Starting as a basic minimum with an 'M' Level CWR06 (1% per thousand hours Established Reliability Failure Rate), the CS3000 is further 100% conditioned by thermal shock and additional low impedance aging to provide an extraordinarily reliable, extremely stable capacitor.

■ From its early stages, the CS3000 has become the standard tantalum chip capacitor of choice for such diverse battery operated applications as medical electronics and satellite systems.

■ To specify CS3000 High Reliability BLUE CHIPS, use an 'X' as the 14th character of the 49BC part number (see Part Number Designation, this section) and state CS3000 after the part number.

■ Limits for Dissipation Factor and DC Leakage on CS3000 BLUE CHIPs are typically specified by the customer. When limits are not specified prior to purchase, the CWR06 electrical limit table will be used.

INDUSTRIAL GRADE BLUE CHIP ELECTRICAL LIMITS & CASE CODES

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	DF 120Hz %	ESR (max)* 120Hz Ω	100KHz Ω	Case Code
2.2	4	0.5	5	7	6	36	9.0	B
4.7	4	0.5	5	7	6	17	5.5	L
6.8	4	0.5	5	7	6	12	3.5	U
10	4	0.5	5	7	8	11	2.0	E
15	4	0.6	6	8	8	7	1.5	C
33	4	1.4	14	18	8	3	1.0	H
68	4	2.8	28	35	10	2	0.8	I
100	4	4.0	40	48	10	2	0.5	P
1.5	6	0.5	5	7	6	53	9.0	B
3.3	6	0.5	5	7	6	24	5.5	L
4.7	6	0.5	5	7	6	17	3.5	U
6.8	6	0.5	5	7	6	12	2.0	E
10	6	0.6	6	8	8	11	1.5	C
22	6	1.4	14	18	8	5	1.0	H
47	6	2.9	29	36	10	3	0.8	I
68	6	4.0	40	48	10	2	0.7	P
1.0	10	0.5	5	7	6	80	9.0	B
2.2	10	0.5	5	7	6	36	5.5	L
3.3	10	0.5	5	7	6	24	3.5	U
4.7	10	0.5	5	7	6	17	2.0	E
6.8	10	0.7	7	9	6	12	2.0	C
15	10	1.5	15	19	8	7	1.0	H
33	10	3.0	30	36	10	4	0.8	I
47	10	4.7	47	59	10	3	0.7	P
.68	15	0.5	5	7	6	120	10.0	B
1.5	15	0.5	5	7	6	53	6.0	L
2.2	15	0.5	5	7	6	36	4.0	U
3.3	15	0.5	5	7	6	24	2.5	E
4.7	15	0.8	8	10	6	17	2.5	C
10	15	1.5	15	19	6	8	1.5	H
22	15	3.3	33	42	8	5	1.0	I
33	15	5.0	50	60	8	3	0.8	P
.47	20	0.5	5	7	6	170	12.0	B
.68	20	0.5	5	7	6	120	8.0	L

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	DF 120Hz %	ESR (max)* 120Hz Ω	100KHz Ω	Case Code
1.0	20	0.5	5	7	6	80	8.0	L
1.5	20	0.5	5	7	6	53	6.0	U
2.2	20	0.5	5	7	6	36	3.5	E
3.3	20	0.7	7	9	6	24	3.0	C
6.8	20	1.4	14	18	6	12	2.5	H
15	20	3.0	30	36	6	6	1.0	I
22	20	4.0	40	48	6	4	1.0	P
.33	25	0.5	5	7	6	240	15.0	B
.68	25	0.5	5	7	6	120	10.0	L
1.0	25	0.5	5	7	6	80	8.0	U
1.5	25	0.5	5	7	6	53	5.0	E
2.2	25	0.6	6	8	6	36	3.5	C
4.7	25	1.2	12	15	6	17	2.5	H
6.8	25	1.7	17	22	6	12	2.0	I
10	25	2.5	25	32	6	8	2.0	I
15	25	3.8	38	48	6	6	1.0	P
.22	35	0.5	5	7	6	360	18.0	B
.47	35	0.5	5	7	6	170	12.0	L
.68	35	0.5	5	7	6	120	9.0	U
1.0	35	0.5	5	7	6	80	6.0	E
1.5	35	0.6	6	8	6	53	5.0	C
3.3	35	1.0	10	12	6	24	2.5	H
4.7	35	1.7	17	22	6	17	2.5	I
6.8	35	2.4	24	30	6	12	2.0	P
.10	50	0.5	5	7	6	800	20.0	B
.15	50	0.5	5	7	6	530	20.0	B
.22	50	0.5	5	7	6	360	15.0	L
.33	50	0.5	5	7	6	240	15.0	L
.47	50	0.5	5	7	6	170	10.0	U
.68	50	0.5	5	7	6	120	8.0	E
1.0	50	0.5	5	7	6	80	6.0	C
1.5	50	0.8	8	10	6	53	5.0	H
2.2	50	1.1	11	14	6	36	3.5	H
3.3	50	1.7	17	22	6	24	2.5	I
4.7	50	2.4	24	30	6	17	2.5	P

*120Hz ESR is maximum at nominal capacitance

49BC CUSTOMER SPECIALS (CS)

■ Special requests from our customers over the years for tantalum chip product that exceeds catalog specifications have given us the opportunity and the impetus to develop application specific chip tantalums with tighter limits and better operating parameters.

■ Recognizing the diverse requirements of many of our customers, Philips Components established the Technical Services Department to act as liaison between our customers and our design, applications and reliability engineering groups.

■ Typical of the design and application problems we've helped solve with product built as 'customer special':

■ Low ESR at high frequency capacitors for applications such as switch-mode power supplies.
■ Modular assemblies for high capacitance density.
■ Adherence to rigid size restrictions far beyond normal.
■ Fabrication of non-polar tantalum chips.
■ Specialized cap shifts (with frequency) for wide-band amplifiers and microwave applications.
■ Fibre-Optics coupling capacitors.
■ Closely matched pairs for critical timing circuits.
■ Electrical parameter limits for Customer Special BLUE CHIPs are not specified here because they are not specified by us. If you have a non-standard application for tantalum chips, call us and let our Technical Services Department review it with you.

CWR06 ESTABLISHED RELIABILITY

■ Series 49BC BLUE CHIP capacitors are qualified to both Exponential Failure Rate Levels (M, P and R) and Weibull Graded Failure Rate Levels (B, C and D) under specification MIL-C-55365/4B, Style CWR06.

■ The military part numbering system and electrical parameter limits for Dissipation Factor and DC Leakage are covered on the following pages. Test information from the military specification follows that, but it is recommended that you obtain the specification and its attendant documents for further clarification of tests and procedures.

Philips Components provides all three termination styles for CWR06 Blue Chips: "A", "B" and "C". The hot solder dipped (60/40) "C" termination is the industry preferred. The "A" termination allows either solder plated or solder dipped; Philips Components provides the "A" termination as (60/40) hot solder dipped.

■ Among the industry-recognized advantages attributed to 60/40 hot soldered terminations are:

■ The only form of coating to insure sufficient solder to meet solder fillet requirements of MIL-STD-883 ("C" termination only).

■ A termination that should conform to steam aging (10 hours) and meet solderability requirements of MIL-STD-202, method 108.
■ Allows long term storage for up to a year and still meets solderability requirements for MIL-STD-202.

ADDITIONAL BLUE CHIP PHYSICAL STATISTICS

CASE CODES		PHYSICAL STATISTICS				Typical Weight
		Substrate Area		Typical Volume		
BC	Mil	sq. in.	sq. cm.	cu. in.	cu. cm.	(grams)
B	A	0.00500	0.0323	0.000250	0.0041	0.02
L	B	0.00750	0.0484	0.000375	0.0062	0.03
U	C	0.01000	0.0645	0.000500	0.0082	0.04
E	D	0.01500	0.0967	0.000750	0.0123	0.07
C	E	0.02000	0.1290	0.001000	0.0164	0.09
H	F	0.02970	0.1930	0.001800	0.0295	0.21
I	G	0.02915	0.1880	0.003200	0.0524	0.33
P	H	0.04275	0.2760	0.004700	0.0770	0.50

STYLE CWR06 ESTABLISHED RELIABILITY
MILITARY STYLE TANTALUM CHIP CAPACITORS

MIL-C-55365/4 MILITARY PART NUMBERING SYSTEM EXAMPLE

CWR06 C B 225 K P

- **FAILURE RATE in percent per 1,000 hours** — M=1%, B=0.1%, P=0.1%, C=0.01%, R=0.01%, D=0.001%
- **CAPACITANCE TOLERANCE** — J=5%, K=10%, M=20%
- **CAPACITANCE, NOMINAL, in Picofarad Code** — First two digits are significant figures, third digit is number of zeros to follow.
- **TERMINATION FINISH** — A=Solder Coated/Plated; B=Gold Plated Nickel (100 μ" Gold); C=Hot Solder Dipped (60/40)
- **RATED VOLTAGE AT 85°C** — C=4, D=6, F=10, H=15, J=20, K=25, M=35, N=50
- **STYLE CWR06 Tantalum Chip Capacitor.**

NOTE: Military Part number does not designate case code

CWR06 ELECTRICAL LIMITS & MILITARY CASE CODES

Cap. (nom) μF	Rated VDC 85°C	DC Leakage (max) 25°C μA	85°C μA	125°C μA	Dissipation Factor (max) 25°C %	85°C 125°C	−55°C %	Case Code (Mil)
2.2	4	1.0	10	12	6	8	8	A
4.7	4	1.0	10	12	6	8	8	B
6.8	4	1.0	10	12	6	8	8	C
10	4	1.0	10	12	8	8	10	D
15	4	1.0	10	12	8	10	12	E
33	4	2.0	20	24	8	10	12	F
68	4	3.0	30	36	10	12	12	G
100	4	4.0	40	48	10	12	12	H
1.5	6	1.0	10	12	6	8	8	A
3.3	6	1.0	10	12	6	8	8	B
4.7	6	1.0	10	12	6	8	8	C
6.8	6	1.0	10	12	6	8	8	D
10	6	1.0	10	12	8	10	12	E
22	6	2.0	20	24	8	10	12	F
47	6	3.0	30	36	10	12	12	G
68	6	4.0	40	48	10	12	12	H
1.0	10	1.0	10	12	6	8	8	A
2.2	10	1.0	10	12	6	8	8	B
3.3	10	1.0	10	12	6	8	8	C
4.7	10	1.0	10	12	6	8	8	D
6.8	10	1.0	10	12	6	8	8	E
15	10	2.0	20	24	8	8	10	F
33	10	3.0	30	36	10	12	12	G
47	10	5.0	50	60	10	12	12	H
.68	15	1.0	10	12	6	8	8	A
1.5	15	1.0	10	12	6	8	8	B
2.2	15	1.0	10	12	6	8	8	C
3.3	15	1.0	10	12	6	8	8	D
4.7	15	1.0	10	12	6	8	8	E
10	15	2.0	20	24	6	8	8	F
22	15	4.0	40	48	8	8	10	G
33	15	5.0	50	60	8	8	10	H
.47	20	1.0	10	12	6	8	8	A
.68	20	1.0	10	12	6	8	8	B

Cap. (nom) μF	Rated VDC 85°C	DC Leakage (max) 25°C μA	85°C μA	125°C μA	Dissipation Factor (max) 25°C %	85°C 125°C	−55°C %	Case Code (Mil)
1.0	20	1.0	10	12	6	8	8	B
1.5	20	1.0	10	12	6	8	8	C
2.2	20	1.0	10	12	6	8	8	D
3.3	20	1.0	10	12	6	8	8	E
6.8	20	2.0	20	24	6	8	8	F
15	20	3.0	30	36	6	8	8	G
22	20	4.0	40	48	6	8	8	H
.33	25	1.0	10	12	6	8	8	A
.68	25	1.0	10	12	6	8	8	B
1.0	25	1.0	10	12	6	8	8	C
1.5	25	1.0	10	12	6	8	8	D
2.2	25	1.0	10	12	6	8	8	E
4.7	25	2.0	20	24	6	8	8	F
6.8	25	2.0	20	24	6	8	8	G
10	25	3.0	30	36	6	8	8	G
15	25	4.0	40	48	6	8	8	H
.22	35	1.0	10	12	6	8	8	A
.47	35	1.0	10	12	6	8	8	B
.68	35	1.0	10	12	6	8	8	C
1.0	35	1.0	10	12	6	8	8	D
1.5	35	1.0	10	12	6	8	8	E
3.3	35	1.0	10	12	6	8	8	F
4.7	35	2.0	20	24	6	8	8	G
6.8	35	3.0	30	36	6	8	8	H
.10	50	1.0	10	12	6	8	8	A
.15	50	1.0	10	12	6	8	8	A
.22	50	1.0	10	12	6	8	8	B
.33	50	1.0	10	12	6	8	8	B
.47	50	1.0	10	12	6	8	8	C
.68	50	1.0	10	12	6	8	8	D
1.0	50	1.0	10	12	6	8	8	E
1.5	50	1.0	10	12	6	8	8	F
2.2	50	2.0	20	24	6	8	8	F
3.3	50	2.0	20	24	6	8	8	G
4.7	50	3.0	30	36	6	8	8	H

MIL-C-55365/4—TEST AND CONDITIONS
(Excerpts from the Military Specification)

CAPACITANCE

■ Capacitors shall be tested in accordance with MIL-STD-202, method 305. The following details shall apply:
(a) Test frequency: 120 ±5 Hertz.
(b) Limit of accuracy: Measurement accuracy shall be within ±2 percent of the reading.
(c) Magnitude of polarizing voltage—Maximum DC bias shall be 2.2 volts for all AC measurements. The magnitude of the AC voltage shall be limited to 1.0 volts RMS.

DISSIPATION FACTOR

■ The dissipation factor of each capacitor shall be measured at a frequency of 120 ±5 Hertz (Hz) by means of a polarized capacitance bridge. The bridge shall provide a dial reading accuracy of 0.1% dissipation factor and a measuring accuracy of ± (2 percent of the measured dissipation factor plus 0.1%).

D.C. LEAKAGE

■ D.C. leakage shall be measured using the DC rated voltage at ±2 percent at the applicable test temperature after a maximum electrification period of 5 minutes. A 1,000-ohm resistor shall be placed in series with the capacitor to limit the charging current. A steady source of power, such as a regulated power supply, shall be used. Measurement accuracy shall be within ±2 percent or 0.02 microamps (μa), whichever is greater.

THERMAL SHOCK

■ Capacitors shall be tested in accordance with MIL-STD-202, method 107. The following details and exceptions shall apply:
(1) Mounting of specimens: Chip capacitors shall be mounted on suitable substrate. The substrate material shall be such that it shall not be cause of, nor contribute to, failure of any test for which it may be used. The capacitors shall be mounted on the substrate as follows:
  (a) A substrate shall be prepared with metalized surface land areas of proper spacing to permit mounting of chips by soldering the terminations of the chips to the "test card" land areas.
  (b) Solder paste, type "R" or "RMA" in accordance with QQ-S-571, shall be applied to terminals or substrates as applicable.
  (c) The chip shall then be placed across the metalized land areas of the substrate so as to make contact between chip and substrate land areas.
  (d) The substrate shall then be placed in or on a suitable heat transfer unit (molten solder, hot plate, tunnel oven, etc.) with the temperature maintained at 260 ±5°C for 2 minutes (+30, −0 seconds), until the solder paste melts and reflows forming a homogeneous solder bond to the metalized substrate.
  (e) All excess flux or solder shall be removed.
(2) Test condition letter: B
(3) Measurements after thermal shock: DC leakage—meet original requirement; Capacitance—shall change no more than 5% from initial measurement; Dissipation Factor—meet original requirement.
(4) Visual requirements: There shall be no evidence of harmful corrosion or mechanical damage.

VIBRATION, HIGH FREQUENCY

■ Capacitors shall be tested in accordance with MIL-STD-202, method 204, The following details and exceptions shall apply:
(a) Mounting of specimens—Capacitors shall be mounted on a substrate as specified under thermal shock.
(b) Electrical-load conditions—During the test, the specified DC rated voltage shall be applied to the capacitors.
(c) Test condition letter—D (20 G's).
(d) Duration and direction of motion—4 hours in each of two mutually perpendicular directions (total of 8 hours), one parallel and the other perpendicular to the axis.
(e) Measurements during vibration—During the last cycle, an electrical measurement shall be made to determine intermittent operation or open or short circuiting. Observations shall also be made to determine intermittent contact or arcing or open or short circuiting. Detecting equipment shall be sufficiently sensitive to detect any interruption with a duration of 0.5 ms or greater.
(f) Measurements after vibration—Not applicable.
(g) Examination after test—Capacitors shall be visually examined for evidence of mechanical damage.

RESISTANCE TO SOLDERING HEAT

■ Capacitors shall be tested in accordance with MIL-STD-202, method 210. The following details and exceptions shall apply:
(a) Mounting of specimens—Chip Capacitors shall be mounted on a substrate as specified in Thermal Shock.
(b) Test condition letter—E.
(c) Cooling time prior to measurement after test—Not applicable.
(d) Examination after test—Capacitors shall be visually examined for evidence of mechanical damage.

MOISTURE RESISTANCE

■ Capacitors shall be tested in accordance with MIL-STD-202, method 106. The following details and expections shall apply:
(a) Mounting of specimens—Capacitors shall be mounted as specified in Thermal Shock.
(b) Initial measurements—Capacitance as specified above.
(c) Number of cycles—20 continuous cycles except that steps 7a and 7b shall be omitted.
(d) Loading voltage—Not applicable.
(e) Final measurements—After removal from chamber, capacitors shall be dried for 1 hour at room temperature and, within the next hour, DC leakage, Capacitance and Dissipation Factor shall be measured as specified above.
(f) Examination after test—Capacitors shall be visually examined for evidence of corrosion and mechanical damage.

■ When tested as specified, capacitors shall meet the following requirements:

■ DC leakage—Shall not exceed 200% of the requirement specified.
■ Capacitance—Shall not change more than ±15% from the initial measured value.
■ Dissipation Factor—Shall not exceed 150% of the requirement specified.
■ Visual examination—There shall be no evidence of harmful corrosion or mechanical damage.

STABILITY AT LOW AND HIGH TEMPERATURE

■ Capacitors shall be dried at 125°C for 30 (+4, −0) minutes prior to start of test. The capacitors shall be brought to thermal stability at each test temperature. Thermal stability will have been reached when no further change in capacitance is observed between two successive measurements taken at 15, +2 −0 minute, intervals. Capacitors will meet the following requirements as applicable:

Step 1 (25°C Initial measurements):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within tolerance of the nominal value.
Dissipation factor—Shall not exceed the requirement specified.

Step 2 (−55°C):
Capacitance—Shall be within ±10% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 3 (25°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within ±5% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 4 (85°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within ±10% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 5 (125°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within ±15% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 6 (25°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within ±5% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

SURGE VOLTAGE

■ Capacitors shall be subjected to 1,000 cycles of the applicable surge voltage. The ambient temperature during cycling shall be 85°C. Each cycle shall consist of a 30-second surge voltage application followed by a 30-second discharge period. Voltage application shall be made through a resistor of 33 ohms. The tolerance of the resistor shall be ±5 percent. Each surge voltage cycle shall be performed in such a manner that the capacitor is shorted terminal-to-terminal through a copper bar, or an equivalent low resistance at the end of the 30-second application. An alternative method of shorting the capacitors is discharge through the same resistance that is utilized for charging. After the final cycle, the capacitor shall be stabilized at the inspection conditions, and the DC leakage, Capacitance, and DF shall be measured. When tested as specified, capacitors shall meet the following requirements:

DC Leakage—Shall not exceed the requirement specified.
Capacitance—Shall change not more than ±5% from initial value.
Dissipation Factor—Shall not exceed the requirement specified.

LIFE TEST

A. Capacitors shall be tested in accordance with MIL-STD-202, method 108. The following details and exceptions shall apply:
   (a) Method of mounting—as detailed under thermal shock.
   (b) Test conditions
      (1) Proof Life
         2,000 hours
         125°C
         Derated voltage applied
      (2) Failure Rate Life
         10,000 hours
         85°C
         Rated voltage applied

B. Operating conditions—DC rated voltage 85°C or derated voltage at 125°C, as applicable, shall be applied gradually (not to exceed 5 minutes) either by a slow build up of the voltage or through a resistor which shall be shorted out within 5 minutes. Voltage shall be applied continuously except during measurement period. The impedance of the voltage source, as seen from the terminals of each capacitor, shall not exceed three ohms. Storage batteries or an electronic power supply capable of supplying at least one ampere when a capacitor is shorted shall be used.

C. Measurements during exposure—DC leakage, at the applicable high test temperature and voltage, shall be measured at the following intervals: 0 hours, 240 hours, 1000 hours, 2000 hours, 4000 hours*, 6000 hours*, 8000 hours*, 10,000 hours*.
   *Failure rate (85°C) life only.

D. Measurements after exposure—Capacitors shall be returned to 25°C and visually examined for evidence of harmful corrosion or mechanical damage. DC leakage, Capacitance and Dissipation Factor will then be measured as specified.

■ Following testing there shall be no evidence of harmful corrosion or mechanical damage and the capacitors will

meet the following electrical requirements:

2,000 hours:
- at 25°C DCL—initial requirement.
  △ Cap—±5% of initially measured value.
  DF—initial requirement.
- at 85°C DCL—initial requirement.
- at 125°C DCL—initial requirement.

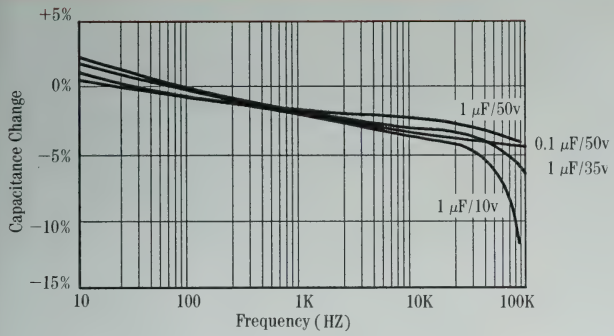
10,000 hours:
- at 25°C DCL—200% of initial requirement.
  △ Cap—within ± 10% of initial measurement.
  DF—initial requirement.
- at 85°C DCL—200% of initial requirement.
- at 125°C DCL—200% of initial requirement.

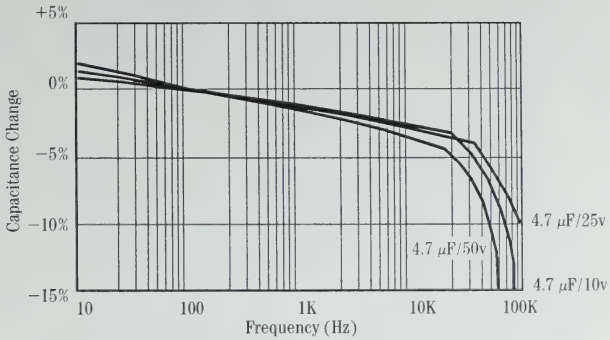
SOLDERABILITY

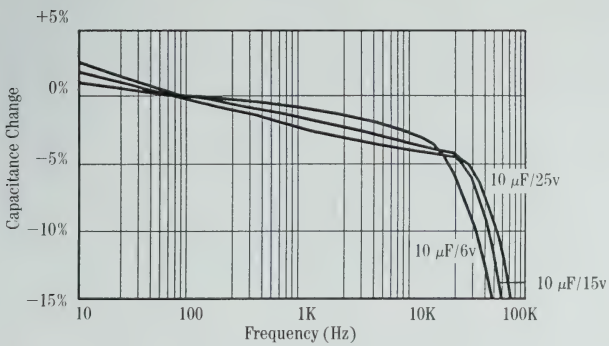
■ Capacitors shall be tested in accordance with MIL-STD-202, method 208. Mounting surfaces shall be dipped to cover the normal mounting surfaces. After the test immersed mounting surface shall be at least 75% covered with a smooth solder coating and shall exhibit no demetallization or leaching of the terminal ends. The remaining 25% may contain only small pin holes or rough spots, these shall not be concentrated in one area.

49BC—BLUE CHIP—TYPICAL CHARACTERISTICS

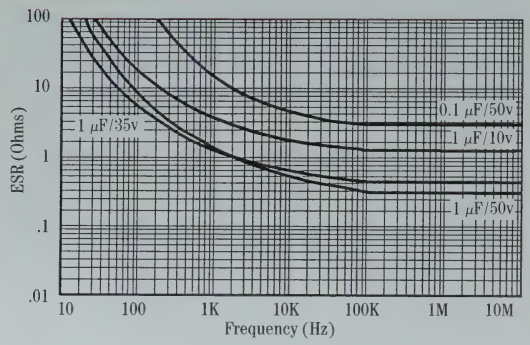
CAPACITANCE CHANGE with FREQUENCY

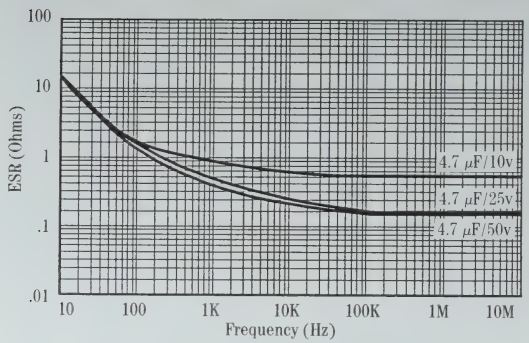


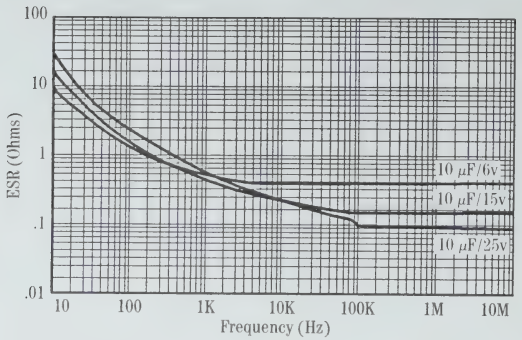




EQUIVALENT SERIES RESISTANCE vs FREQUENCY







49BC–BLUE CHIP–APPLICATION NOTES

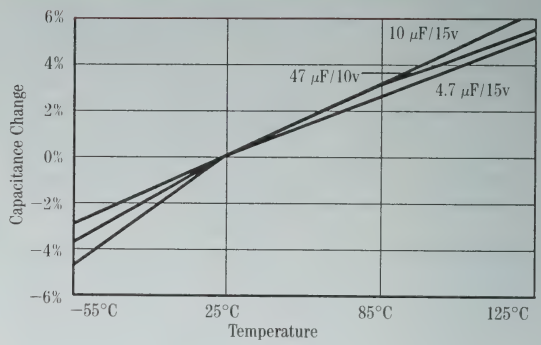
DESIGNING WITH BLUE CHIPS

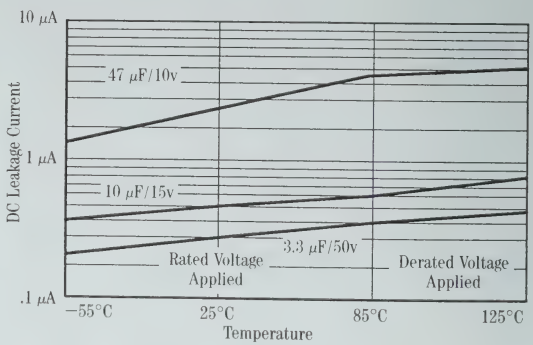
■ Philips Components BLUE CHIP Series capacitors are designed for use in thin and thick film hybrid circuits utilizing a variety of mounting techniques and in surface mount applications where soldering times and temperatures preclude the use of other styles of tantalum chip construction. BLUE CHIPs are an excellent choice for circuit applications involving filtering, coupling, decoupling, bypass and timing.

OPERATING TEMPERATURE

■ BLUE CHIP capacitors are intended for circuits operating at rated voltage between −55°C and 85°C. When linearly derated to 2/3 of working voltage, operation to 125°C is allowed.

TEMPERATURE CHARACTERISTICS



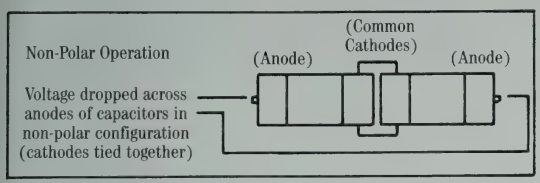


RELIABILITY DERATING

■ At normal operating temperatures, BLUE CHIP capacitors can be operated at less than rated voltage with a proportionate increase in reliability and no degradation of capacitor electrical parameters.

NON-POLAR CONFIGURATION

■ In circuits where voltage reversals exceeding 15% at 25°C occur, or where AC ripple voltages are high, BLUE CHIPs should be mounted in pairs in a cathode to cathode arrangement to effect non-polar operation.



■ In these cases, if two identical BLUE CHIPs are mounted back to back, the resulting capacitance will be ½ the value of the original devices and the voltage rating will be the same as the rating of the original devices. The positive peak AC voltage plus the DC voltage must not exceed the rated voltage of the capacitor in either direction.

HANDLING

■ Manual: The use of vacuum pencils or plastic tipped tweezers is recommended. Specify 'Blister Pack' packaging.

■ Automatic: Because BLUE CHIP capacitors are physically rugged, they can be automatically dispensed by vibration type feed bowls (specify 'Blister Pack' packaging) or by automatic tape fed placement equipment (specify Tape & Reel packaging). Other types of packaging (as specified by customer) will be considered.

MOUNTING MATERIALS

■ Most hybrid circuits use various materials in the substrate and pads which have differing coefficients of expansion. Therefore, Philips Components has designed its BLUE CHIP to be compatible with solder, epoxy and thermal compression bonding based upon the type termination specified. The "U" shaped termination and method of attachment isolates the capacitor from the substrate, making the BLUE CHIP totally compatible with all substrate materials, regardless of thermal mismatch.

■ Both conductive adhesives and solder pastes or creams lend themselves to production techniques because they can be accurately and rapidly screened onto the pads using masks. They also have a precure tackiness permitting chip placement prior to curing.

■ Conductive adhesives have the advantage of lower temperature cure mechanisms than those required for solder attachment. They do not require post attachment cleaning and defluxing cycles. Conductivity and joint strength will vary widely depending on the adhesive formulation and curing profile.

■ Soft metal solder attachment allows the widest latitude of conditions while still providing satisfactory attachment. While optimum joint strength and a low resistance connection are obtained, soldering does require a complex cleaning sequence to remove all traces of fluxes and any entrained contaminants.

■ BLUE CHIP termination materials are totally compatible with all soft metal solders which provide optimum joint strength over wide temperature excursions and all commercially available fluxing systems. Either water or solvent based fluxing systems may be used.

MOUNTING TECHNIQUES

■ WIRE BONDING—The BLUE CHIP's standard termination finish, 100 micro inches of soft gold plated over a .005" nickel clip, provides the optimum surface for either thermal compression or ultrasonic wire bonding. Gold plated terminations must be specified for these applications. In a typical application, the chip is glued down "on its back" with the mounting side up, and two wires (repetitive connections) are bonded to each of the positive and negative terminations.

■ CONDUCTIVE ADHESIVE—For mounting with conductive adhestive, gold plated terminations are recommended. (A cautionary note when working with conductive adhesives: curing the adhesive at the lowest acceptable temeprature for a longer time will minimize the possibility of forming "hairline" cracks in the adhesive during the cure.)

■ SOLDER ATTACH—For mounting by means of reflow soldering, 60/40 solder dipped terminations should be specified. The exception to soft metal soldering is the use of Indium/Lead solder, in which case gold plated terminiations should be specified. Any of the methods of solder reflow currently in use in the industry may be used with BLUE CHIP capacitors.

■ Hand Soldering—It is difficult to control soldering conditions when applying heat with a soldering iron. The solder dipped BLUE CHIP is recommended because the only requirement is to melt the solder of the termination rather than raise the temperature high enough to make a metallurgical bond to the base metal. A 600°F chisel tip iron is recommended, with application of the tip to the interface between the chip termination and the substrate pad. By minimizing the time necessary to reflow the solder, a minimum of heat is transferred to the capacitor body.

■ Hot Plate—This method has advantages over hand soldering for small quantity assembly operations. The temperature is easily controlled and all terminations are reflowed simultaneously. A reflow temperature of 230°C is recommended for alumina substrates. Higher temperatures or longer durations may be required for other substrate material. Preheating to 160°C prior to reflow will provide proper fluxing activation. Room temperature "cool-down" is all that is necessary.

■ Belt Reflow—The advantages of this method is that it provides a uniform increase in temperature to properly activate the fluxing system prior to reflow. The setting of the temperature will depend on the mass being reflowed. The belt speed and heat source should be adjusted or alignment of components should be such that one termination of any component does not reach liquidus temperature before the other. The capillary action or surface tension of the liquid solder could pull the component askew on the pads.

■ Infra-Red (IR)—The same recommendations apply to IR soldering as Belt Reflow with an additional caution that reflective surfaces will have an effect on heat absorption.

■ Wave Soldering—The same recommendations as above apply to this reflow method. Additionally, pre-heating prior to immersing the capacitors in liquid solder has to be considered a necessity rather than a recommendation in order to ensure proper flux activation. Gluing of the device to the substrate is normally required prior to wave soldering.

■ Vapor Phase—The design and construction of the BLUE CHIP and its ability to withstand longer durations at higher temperatures make it better suited for vapor phase reflow than other styles of tantalum chip construction. BLUE CHIPs will withstand the rapid rise to temperature inherent in the vapor phase system. The solid metal terminations will not de-wet.

CLEANING

■ The fluoroelastomer conformal coating prevents intrusion of any contaminates present in the cleaning process. It is compatible with most commonly used cleaning methods and solvents. This includes methods such as ultrasonic, hot and cold solvent sprays, vapor degreasing and detergent washes. All commercially available, commonly used solvents are compatible with the BLUE CHIP family of capacitors.

RECOMMENDED PAD DIMENSIONS FOR WAVE SOLDERING

CASE SIZE	A MIN.	B MIN.	C NOM.	D NOM.
B	.044 (1.11)	.067 (1.70)	.030 (0.77)	.204 (5.17)
L	.044 (1.11)	.067 (1.70)	.080 (2.04)	.254 (6.44)
U	.044 (1.11)	.067 (1.70)	.130 (3.31)	.304 (7.71)
E	.077 (1.96)	.067 (1.70)	.080 (2.04)	.254 (6.44)
C	.077 (1.96)	.067 (1.70)	.130 (3.31)	.304 (7.71)
H	.101 (2.55)	.067 (1.70)	.150 (3.82)	.324 (8.22)
I	.084 (2.13)	.087 (2.21)	.155 (3.94)	.369 (9.36)
P	.111 (2.81)	.087 (2.21)	.175 (4.45)	.389 (9.88)

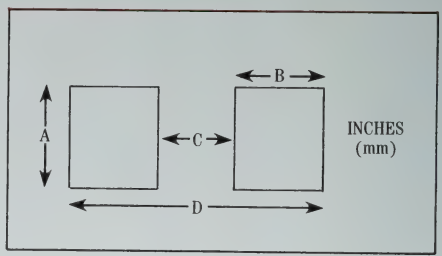
REFLOW TIMES and TEMPERATURES

■ The optimum reflow profile will include a preheat cycle to provide proper flux activation prior to reflow.

■ It is axiomatic that the shortest time and the lowest reflow temperature will provide the greatest circuit reliability.

■ Multiple reflow passes are permissible as required in many manufacturing operations. This makes it possible to remove and/or replace other components on the board without fear of degrading the BLUE CHIP capacitors.

RECOMMENDED PAD DIMENSIONS FOR REFLOW SOLDERING



CASE SIZE	A MIN.	B MIN.	C NOM.	D NOM.
B	.085 (2.15)	.062 (1.58)	.030 (0.77)	.204 (5.17)
L	.085 (2.15)	.062 (1.58)	.080 (2.04)	.254 (6.44)
U	.085 (2.15)	.062 (1.58)	.130 (3.31)	.304 (7.71)
E	.135 (3.42)	.062 (1.58)	.080 (2.04)	.254 (6.44)
C	.135 (3.42)	.062 (1.58)	.130 (3.31)	.304 (7.71)
H	.170 (4.31)	.062 (1.58)	.150 (3.82)	.324 (8.22)
I	.145 (3.67)	.082 (2.08)	.155 (3.94)	.369 (9.36)
P	.185 (4.45)	.082 (2.08)	.175 (4.45)	.389 (9.88)

SERIES 49SC STAR CHIP Tantalum SMD® (Chip) Capacitors

DESCRIPTION

■ The 49SC/STAR CHIP Series is a companion to the patented Philips Components Blue Chip, which has gained world-wide acceptance as the ultra high reliability capacitive component for military electronics and other sophisticated micro-electronic systems. It is a cost-effective alternative to the Blue Chip in high volume industrial applications.

■ The 49SC Series provides maximum volumetric efficiency in a conformally coated device. The capacitive element is protected from external contaminates by a proprietary conformal coating.

■ The STAR CHIP is available in five standard case sizes which are physically similar to the Blue Chip and directly pad-compatible with MIL-C-55365/4 (CWR-06 style) capacitors.

■ Philips Components 49SC series is especially suited for use on SMD circuit boards, as well as in thick or thin film hybrid circuits, where cap values between .47 μF and 100 μF are required.

■ STAR CHIP Surface Mount Devices are supplied in 12 mm embossed tape for efficiency in handling and storage as well as being compatible with all tape-fed high speed placement equipment.

■ Electrical characteristics such as low leakage current and low equivalent series resistance at high frequencies make the Star Chip an excellent choice for circuits where actual performance must be weighed against low initial cost.

■ Philips Components manufactures the STAR CHIP products utilizing advanced Statistical Process Control methods (SPC). The use of Statistical Process Control techniques provides a very consistent and reliable product.

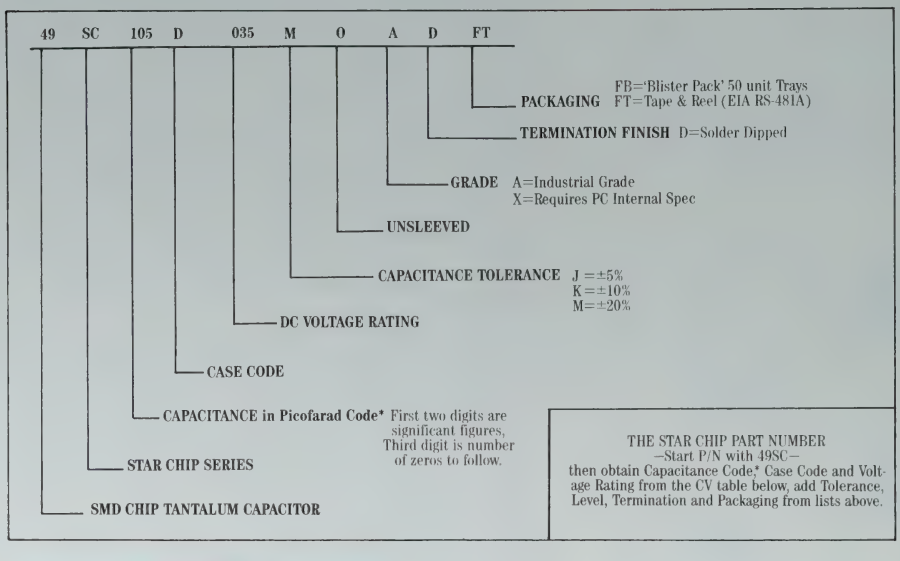
FEATURES

- −55°C through +85°C Operation (125°C with Voltage Derating)
- Capacitance Range: .47 μF to 100 μF
- Rated Voltages: 4 VDC to 50 VDC
- Five Standard Case Sizes D, E, F, G, H (Pad-Compatible with CWR-06)
- Low ESR in High-Frequency Applications
- Solder-Dipped Terminations Ideally Suited for Solder Reflow Techniques
- Conformally Coated Construction Provides Maximum Volumetric Efficiency
- Uniform Physical Dimensions
- Standard 12 mm Tape & Reel Packaging

®SMD is a Service Mark of North American Philips Corporation
®STAR CHIP is a Registered Trade Mark.
The Star Chip is patented under US Patent No. 4,571,664

PART NUMBER DESIGNATION

Philips Components Series 49SC Capacitors can be completely specified using the following designation:


49 SC 105 D 035 M 0 A D FT
PACKAGING FB='Blister Pack' 50 unit Trays FT=Tape & Reel (EIA RS-481A)
TERMINATION FINISH D=Solder Dipped
GRADE A=Industrial Grade X=Requires PC Internal Spec
UNSLEEVED
CAPACITANCE TOLERANCE J=±5% K=±10% M=±20%
DC VOLTAGE RATING
CASE CODE
CAPACITANCE in Picofarad Code* First two digits are significant figures, Third digit is number of zeros to follow.
STAR CHIP SERIES
SMD CHIP TANTALUM CAPACITOR
THE STAR CHIP PART NUMBER
—Start P/N with 49SC—
then obtain Capacitance Code,* Case Code and Voltage Rating from the CV table below, add Tolerance, Level, Termination and Packaging from lists above.

PHYSICAL SPECIFICATIONS

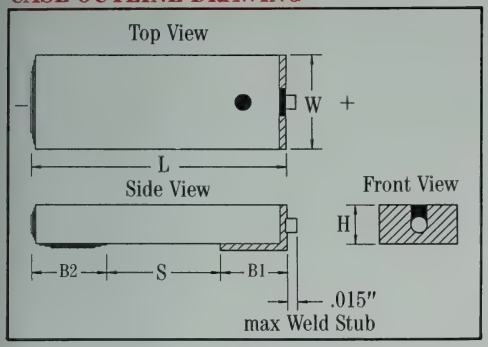
DIMENSIONS—Inches

CASE CODE	(W) WIDTH ±0.015	(L) LENGTH ±0.015	(H) HEIGHT ±0.015	(S) SPACING Typical	(B1) +PAD WIDTH ±0.010	(B2) −PAD WIDTH −.010/+.025
D	.100	.150	.050	.090	.030	.030
E	.100	.200	.050	.140	.030	.030
F	.135	.220	.070	.160	.030	.030
G	.110	.265	.110	.165	.050	.050
H	.160	.275	.110	.175	.050	.050

DIMENSIONS—mm

CASE CODE	(W) WIDTH ±0.381	(L) LENGTH ±0.381	(H) HEIGHT ±0.381	(S) SPACING Typical	(B1) +PAD WIDTH ±0.254	(B2) −PAD WIDTH −.254/+.635
D	2.54	3.81	1.27	2.29	0.76	0.76
E	2.54	5.08	1.27	3.56	0.76	0.76
F	3.43	5.59	1.78	4.06	0.76	0.76
G	2.79	6.73	2.79	4.19	1.27	1.27
H	4.06	7.25	2.79	4.44	1.27	1.27

CASE OUTLINE DRAWING



NOTES:

1. For polarity identification, when chip is in mounting position, metal "L" clip and weld stub are positive. In addition, the positive end is marked with a dot. The top negative surface is conformally coated.
2. Metric Equivalents are for general information purposes only and are based on 1″=25.4 mm.
3. Anode Riser (Weld Stub) may extend case size Length dimension by 0.015″ (.38 mm) max.
4. Spacing dimension is typical distance between chip mounting terminations and therefore average distance between mounting pads on substrate.

49SC CAPACITANCE–VOLTAGE–CASE CODE TABLE

Select standard Capacitance/Voltage ratings and corresponding standard STAR CHIP case codes from this table.

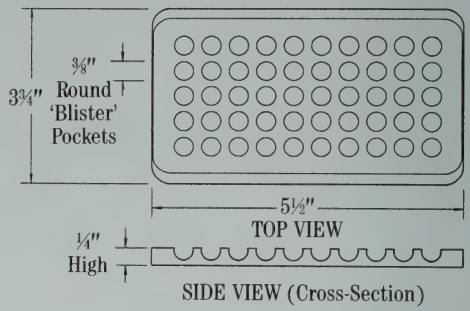
CAP μF	PICOFARAD CODE*	004 V	006 V	010 V	015 V	020 V	025 V	035 V	050 V
0.47	474	D	D	D	D	D	D	D	D
0.68	684	D	D	D	D	D	D	D	D
1.0	105	D	D	D	D	D	D	D	E
1.5	155	D	D	D	D	D	D	E	F
2.2	225	D	D	D	D	D	E	F	F
3.3	335	D	D	D	D	E	F	F	G
4.7	475	D	D	D	E	F	F	G	H
6.8	685	D	D	E	F	F	G	H	
10.0	106	D	E	F	F	G	G		
15.0	156	E	F	F	G	G	H		
22.0	226	F	F	G	G	H			
33.0	336	F	G	G	H				
47.0	476	G	G	H					
68.0	686	G	H						
100.0	107	H							

PACKAGING

BLISTER-PACK TRAYS

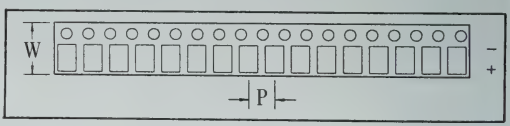
■ 49SC Series capacitors are available in 'Blister Pack' trays containing 50 pieces each in a 5 x 10 matrix configuration. The Blister Pack provides a separate pocket for each unit to prevent damage to the capacitors during shipping, handling and storage.

■ Blister Pack trays are stamped polystyrene with a clear plastic cover. Orientation of the capacitors within the pockets is random with respect to polarity and mounting surface. This packaging is ideal for hand placement of the capacitors as it takes up very little room at a work station. It is recommended that operators remove and work with the STAR CHIPs using a blunt, coated tweezer to prevent damage to the conformal coating.



TAPE & REEL

■ 49SC Series capacitors are shipped in Tape & Reel packaging to facilitate the use of automatic placement equipment. Tape & Reel is per EIA (Electronic Industries Association) specification RS-481A. Capacitor orientation within tape pockets is negative terminal toward sprocket holes and mounting side down. 12 mm width tape is used. Quantities less than minimum reel will be shipped in Blister Pack trays.



TAPE & REEL SPECIFICATIONS

49SC Case Code	(W) Tape Width	(P) Unit Pitch Ctr/Ctr	Quantity per full 7" Reel	Minimum Quantity per Reel
D	12 mm	4 mm	2,700	1,350
E	12 mm	4 mm	2,700	1,350
F	12 mm	8 mm	1,000	500
G	12 mm	8 mm	700	350
H	12 mm	8 mm	700	350

APPLICATION NOTES

CAPACITANCE

■ Capacitance shall be measured at or referred to 120 Hz at 25°C. The AC signal shall not exceed 1.0 VRMS.

■ TOLERANCE—Type 49SC are available in ±20%, ±10% and ±5% capacitance tolerances.

■ CAPACITANCE CHANGE WITH TEMPERATURE—from 25°C reading (maximum):
at −55°C −10% Δ
at +85°C +10% Δ
at +125°C +15% Δ

DC LEAKAGE CURRENT (DCL)

■ DCL shall be measured at WVDC after a 5 minute electrification period with a 1000 ohm current-limiting resistor in series.

VOLTAGE RATING

■ STAR CHIPS can be used at elevated temperatures when voltage is derated in accordance with the following:

Rated WVDC −55°C to 85°C	Derated (DC) 125°C	Surge Voltage (DC) 85°C	Surge Voltage (DC) 125°C
4	2.7	5.0	3.4
6	4.0	8.0	5.0
10	7.0	13.0	9.0
15	10.0	20.0	12.0
20	13.0	26.0	16.0
25	17.0	32.0	20.0
35	23.0	46.0	26.0
50	33.0	65.0	38.0

STAR CHIP ELECTRICAL LIMITS & CASE CODES

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	DF 120Hz %	ESR 120Hz Ω	ESR 100KHz Ω	Case Code
2.2	4	0.5	5	7	6	36	3.5	D
4.7	4	0.5	5	7	6	17	2.0	D
6.8	4	0.5	5	7	6	12	2.0	D
10	4	0.5	5	7	8	11	2.0	D
15	4	0.6	6	8	8	7	1.5	E
33	4	1.4	14	18	8	3	1.0	F
68	4	2.8	28	35	10	2	0.8	G
100	4	4.0	40	48	10	2	0.5	H
1.5	6	0.5	5	7	6	53	5.0	D
3.3	6	0.5	5	7	6	24	2.5	D
4.7	6	0.5	5	7	6	17	2.0	D
6.8	6	0.5	5	7	6	12	2.0	D
10	6	0.6	6	8	8	11	1.5	E
22	6	1.4	14	18	8	5	1.0	F
47	6	2.9	29	36	10	3	0.8	G
68	6	4.0	40	48	10	2	0.7	H
1.0	10	0.5	5	7	6	80	6.0	D
2.2	10	0.5	5	7	6	36	3.5	D
3.3	10	0.5	5	7	6	26	2.5	D
4.7	10	0.5	5	7	6	17	2.0	D
6.8	10	0.7	7	9	6	12	2.0	E
15	10	1.5	15	19	8	7	1.0	F
33	10	3.0	30	36	10	4	0.8	G
47	10	4.7	47	59	10	3	0.7	H
.68	15	0.5	5	7	6	120	8.0	D
1.5	15	0.5	5	7	6	53	5.0	D
2.2	15	0.5	5	7	6	36	3.5	D
3.3	15	0.5	5	7	6	24	2.5	D
4.7	15	0.8	8	10	6	17	2.5	E
10	15	1.5	15	19	6	8	1.5	F
22	15	3.3	33	42	8	5	1.0	G
33	15	5.0	50	60	8	3	0.8	H
.47	20	0.5	5	7	6	170	12.0	D
.68	20	0.5	5	7	6	120	8.0	D

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	DF 120Hz %	ESR 120Hz Ω	ESR 100KHz Ω	Case Code
1.0	20	0.5	5	7	6	80	8.0	D
1.5	20	0.5	5	7	6	53	5.0	D
2.2	20	0.5	5	7	6	36	3.5	D
3.3	20	0.7	7	9	6	24	3.0	E
6.8	20	1.4	14	18	6	12	2.5	F
15	20	3.0	30	36	6	6	1.0	G
22	20	4.0	40	48	6	4	1.0	H
.33	25	0.5	5	7	6	240	15.0	D
.68	25	0.5	5	7	6	120	10.0	D
1.0	25	0.5	5	7	6	80	8.0	D
1.5	25	0.5	5	7	6	53	5.0	D
2.2	25	0.6	6	8	6	36	3.5	E
4.7	25	1.2	12	15	6	17	2.5	F
6.8	25	1.7	17	22	6	12	2.0	G
10	25	2.5	25	32	6	8	1.5	G
15	25	3.8	38	48	6	6	1.0	H
.22	35	0.5	5	7	6	360	18.0	D
.47	35	0.5	5	7	6	170	10.0	D
.68	35	0.5	5	7	6	120	7.0	D
1.0	35	0.5	5	7	6	80	6.0	D
1.5	35	0.6	6	8	6	53	5.0	E
3.3	35	1.0	10	12	6	24	2.5	F
4.7	35	1.7	17	22	6	17	2.0	G
6.8	35	2.4	24	30	6	12	1.5	H
.47	50	0.5	5	7	6	170	8.0	D
.68	50	0.5	5	7	6	120	6.0	D
1.0	50	0.5	5	7	6	80	5.5	E
1.5	50	0.8	8	10	6	53	4.5	F
2.2	50	1.1	11	14	6	36	3.0	F
3.3	50	1.7	17	22	6	24	1.5	G
4.7	50	2.4	24	30	6	17	1.5	H

AC POWER DISSIPATION

CASE CODE	MAXIMUM POWER DISSIPATION IN WATTS AMBIENT TEMPERATURE		
	25°C	85°C	125°C
D	.095	.085	.038
E	.100	.090	.040
F	.125	.112	.050
G	.150	.135	.060
H	.200	.180	.080

■ Major physical factors which limit the ability of the capacitor to dissipate internally generated heat produced during AC circuit operation, include unit construction features as related to a particular capacitor design, and heat transfer characteristics of the materials used in the construction of the capacitor. Larger volumetric packages exhibiting electrical characteristics similar to those of smaller physical packages will, under similar conditions, be capable of dissipating more power. Conformally coated capacitors, such as the Star Chip series, exhibit more efficient heat dissipation capabilities, due to the absence of relatively thick thermally insulative coatings, as incorporated in "molded" tantalum chip capacitor styles.

■ Maximum power dissipation levels shown represent an empirically determined wattage level required to cause a 10 degree centigrade temperature increase above the stated temperature in "still air" as measured on the external capacitor body, utilizing a thermo-couple or other appropriate measuring device.

AC RIPPLE CURRENT

■ Circuit design and physical layout should provide "cool" circuit board locations for capacitors operating at high AC current levels. Capacitor temperature may increase due to heat transfer/absorption from the ambient environment or a "hot" component mounted in close proximity to the capacitor. The result of increased AC current is increased internal heat generation within the capacitor body. Waveform envelope is also a factor in the amount of internal heat generated within the capacitor since non-sinusoidal waveshapes produce heating effects different from those of sinusoidal waveforms.

■ The ripple current and voltage level impressed across the capacitor should not exceed the maximum power dissipation of the capacitor unless special provisions are made to increase the rate of heat dissipation from the body of the capacitor, such as by the use of a heat sink or providing air flow. Excessive power dissipation in tantalum chip capacitors may cause catastrophic failure. The I_{max} value of current must be used to determine the operating conditions.

■ The maximum permissible AC (rms) current applied across the capacitor is related to the equivalent series resistance (ESR) and the physical power dissipation capability of the capacitor. The maximum (rms) ripple current at a given frequency may be determined by:

$$I_{max}\,(rms) = \sqrt{Pdm/ESR}$$

where...Pdm = Maximum Power Dissipation in watts, at the maximum circuit operating temperature

$$ESR = \frac{1}{2\pi * \text{AC Frequency} * \text{Capacitance}} * \text{D.F.}$$

AC Frequency in Hertz
Capacitance is in Farads
Dissipation Factor is in decimal form

AC RIPPLE VOLTAGE

■ The maximum AC ripple voltage at the applied frequency must be limited to an rms value which permits only the recommended maximum power dissipation specified for a given case code.

■ The maximum AC ripple voltage may be determined by:

$$E_r\,(rms) = Z\sqrt{Pdm/ESR}$$

where...E_r = AC Ripple Voltage
Z is the Impedance in ohms
Pdm is the Maximum Power Dissipation in watts, at the maximum circuit operating temperature
ESR is the Equivalent Series Resistance in ohms

■ Both voltage and current levels at a given frequency must be maintained so as not to exceed the recommended maximum power dissipation levels at the maximum circuit operating temperature. The DC bias voltage applied in series with the AC source applied across polar style capacitors, on which the AC voltage is "riding," may be ignored when considering the heating effects of AC current on the capacitor. The positive peak AC voltage plus the DC voltage must not exceed the rated DC voltage of the capacitor. The negative peak AC voltage in combination with the DC voltage may not obtain a level which will damage the dielectric due to reverse voltage being applied across a polar solid electrolyte tantalum chip capacitor.

REVERSE VOLTAGE

■ Series 49SC hybrid capacitor will withstand momentary voltage reversals up to 15% at 25°C, 10% at 55°C and 1% at 125°C of their rated voltage.

MARKING

■ The small physical size of the STAR CHIP does not permit alpha-numeric marking on the body of the capacitor. Color dots on the body of the capacitor are available on special order, if required. Series 49SC capacitors are identified in their package container.

POLARITY

■ Series 49SC capacitors are polar devices. Proper polarity must be observed or damage to the capacitor and/or the circuit will result. Polarity is marked with a dot or stripe on the positive (anode) end.

NON-POLAR OPERATION

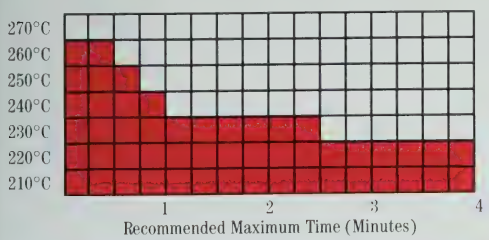
■ When two polar capacitors of the same DC voltage rating are connected back-to-back in non-polar configuration, i.e. positive-to-positive terminals or negative-to-negative terminals; the "non-polar" pair may be operated without DC bias voltage. If DC voltage is applied, the positive peak AC voltage plus the DC voltage must not exceed the rated voltage of the capacitor in either direction.

SURFACE-MOUNT APPLICATION

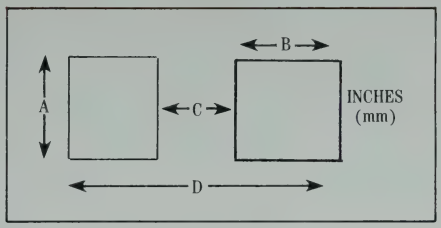
■ STAR CHIP capacitors are ideally suited for use on SMD circuit boards where circuit density requires the use of components with the highest cap/unit volume efficiency. Current solder reflow techniques such as IR (Infra-Red), Wave Soldering and Vapor Phase may be utilized with these capacitors.

REFLOW TIMES and TEMPERATURES

■ The optimum reflow profile will include a preheat cycle to provide proper fluxing prior to reflow.

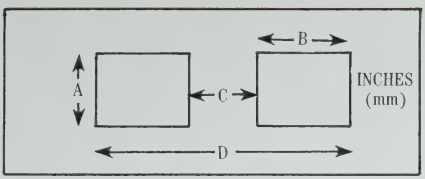


RECOMMENDED PAD DIMENSIONS FOR REFLOW SOLDERING



CASE SIZE	A MIN.	B MIN.	C NOM.	D NOM.
D	.135 (3.42)	.062 (1.58)	.080 (2.04)	.254 (6.44)
E	.135 (3.42)	.062 (1.58)	.130 (3.31)	.304 (7.71)
F	.170 (4.31)	.062 (1.58)	.150 (3.82)	.324 (8.22)
G	.145 (3.67)	.082 (2.08)	.155 (3.94)	.369 (9.36)
H	.195 (4.94)	.082 (2.08)	.165 (4.20)	.379 (9.62)

RECOMMENDED PAD DIMENSIONS FOR WAVE SOLDERING



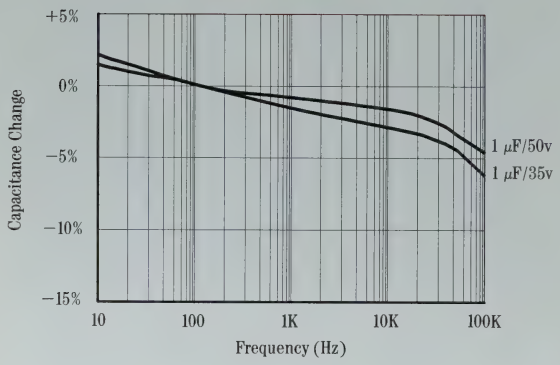
CASE SIZE	A MIN.	B MIN.	C NOM.	D NOM.
D	.077 (1.96)	.067 (1.70)	.080 (2.04)	.254 (6.44)
E	.077 (1.96)	.067 (1.70)	.130 (3.31)	.304 (7.71)
F	.101 (2.55)	.067 (1.70)	.150 (3.81)	.324 (8.22)
G	.084 (2.13)	.087 (2.21)	.155 (3.94)	.369 (9.36)
H	.117 (2.98)	.087 (2.21)	.165 (4.20)	.379 (9.62)

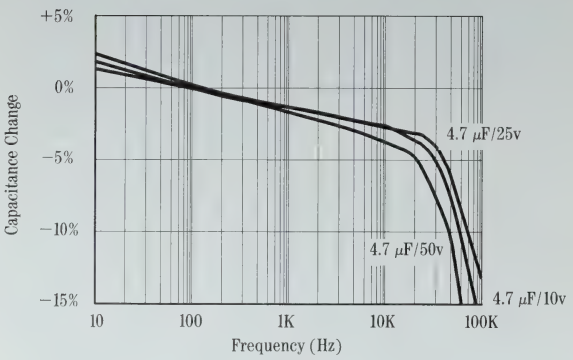
ADDITIONAL PHYSICAL STATISTICS

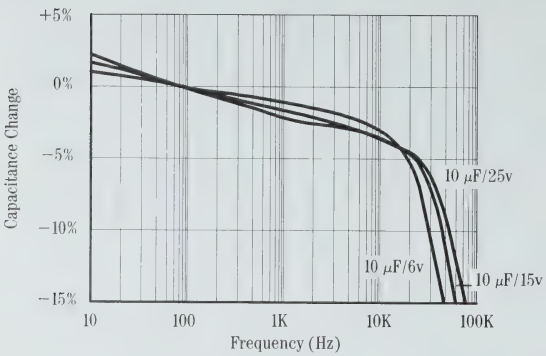
CASE CODE	PHYSICAL STATISTICS				Typical Weight (grams)
	Substrate Area		Typical Volume		
	sq. in.	sq. cm	cu. in.	cu. cm	
D	0.01500	0.0967	0.000750	0.0123	0.07
E	0.02000	0.1290	0.001000	0.0164	0.09
F	0.02970	0.1917	0.002079	0.0341	0.18
G	0.02915	0.1878	0.003200	0.0524	0.27
H	0.04400	0.2838	0.00484	0.0792	0.44

TYPICAL CHARACTERISTICS

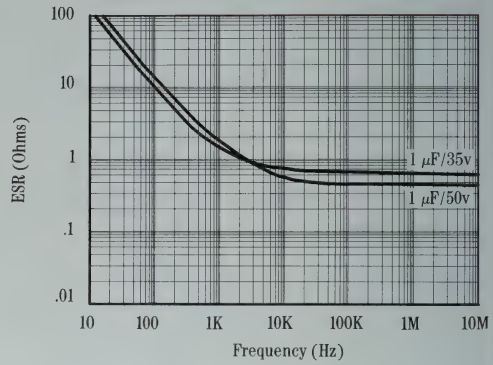
CAPACITANCE CHANGE with FREQUENCY

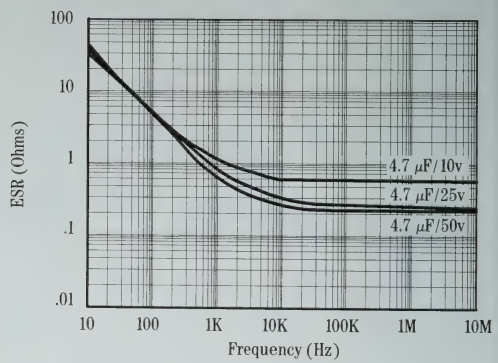


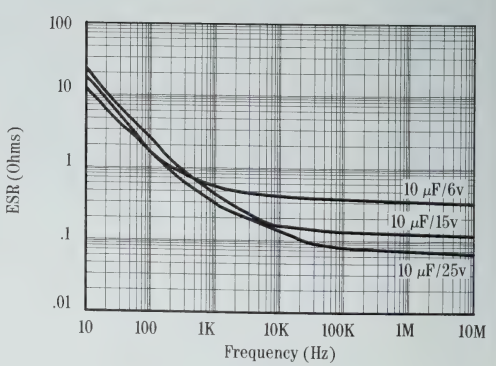




EQUIVALENT SERIES RESISTANCE vs FREQUENCY







SERIES 49UC ULTRA CHIP Tantalum SMD® (Chip) Capacitors

DESCRIPTION

■ The 49UC ULTRA CHIP Series is a companion to the patented Philips Components Blue Chip, which has gained world-wide acceptance as the ultra high reliability capacitive component for military electronics and other sophisticated micro-electronic systems. It is a cost-effective alternative to the Blue Chip in high volume industrial applications.

■ The 49UC Series provides maximum volumetric efficiency in a conformally coated device. The capacitive element is protected from external contaminates by a proprietary conformal coating.

■ The ULTRA CHIP is available in three standard sizes which are physically similar to the Blue Chip and directly pad-compatible with MIL-C-55365/4 (CWR-06) style capacitors.

■ Philips Components 49UC series is especially suited for use on SMD circuit boards, as well as in thick or thin film hybrid circuits, where cap values between 0.1 μF and 6.8 μF are required.

■ ULTRA CHIP Surface Mount Devices are supplied in 8 and 12 mm embossed tape for efficiency in handling and storage as well as being compatible with all tape-fed high speed placement equipment.

■ Electrical characteristics such as low leakage current, and low equivalent series resistance and minimum capacitance shift at high frequencies make the ULTRA CHIP an excellent choice for circuits where actual performance must be weighed against low initial cost.

■ Philips Components manufactures the ULTRA CHIP products utilizing advanced Statistical Process Control methods (SPC). The use of Statistical Process Control techniques provides a very consistent and reliable product.

FEATURES

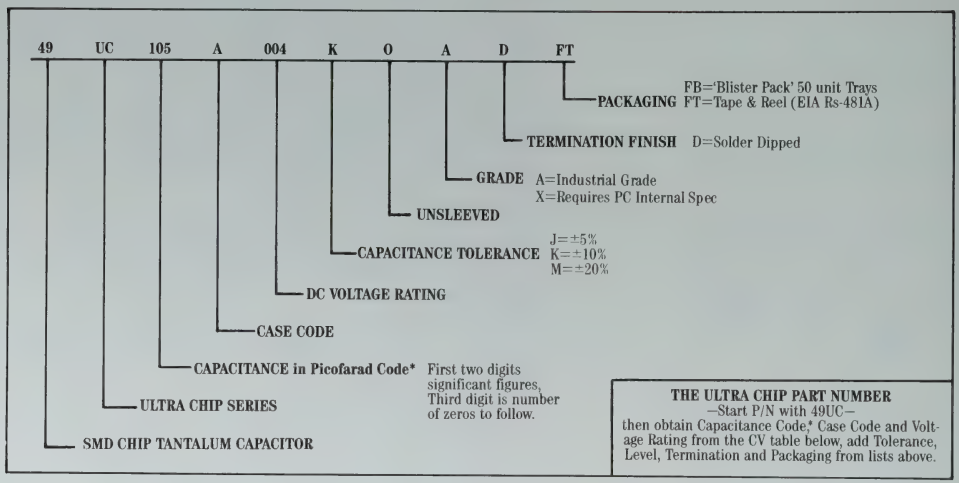
- −55°C through +85°C Operation (125°C with Voltage Derating)
- Capacitance Range: 0.1 μF to 6.8 μF
- Rated Voltages: 4 VDC to 50 VDC
- Three Standard Case Sizes A, B, C (Pad-Compatible with CWR-06)
- Low Electrical losses and minimum capacitance shift in High-Frequency Applications
- Solder-Dipped Terminations Ideally Suited for Solder Reflow Techniques
- Conformally Coated Construction Provides Minimum Height as well as the Ultimate in Real Estate Efficiency
- Standard Tape & Reel Packaging

49UC is pad-compatible with CWR06 (Mil-C-55365/4) A, B, and C case sizes.

®SMD is a Service Mark of North American Philips Corporation

PART NUMBER DESIGNATION

Philips Components Series 49UC ULTRA CHIP Capacitors can be completely specified using the following designation:


49 UC 105 A 004 K 0 A D FT
PACKAGING FB='Blister Pack' 50 unit Trays FT=Tape & Reel (EIA Rs-481A)
TERMINATION FINISH D=Solder Dipped
GRADE A=Industrial Grade X=Requires PC Internal Spec
UNSLEEVED
CAPACITANCE TOLERANCE J=±5% K=±10% M=±20%
DC VOLTAGE RATING
CASE CODE
CAPACITANCE in Picofarad Code* First two digits significant figures, Third digit is number of zeros to follow.
ULTRA CHIP SERIES
SMD CHIP TANTALUM CAPACITOR
THE ULTRA CHIP PART NUMBER
—Start P/N with 49UC—
then obtain Capacitance Code,* Case Code and Voltage Rating from the CV table below, add Tolerance, Level, Termination and Packaging from lists above.

49UC CAPACITANCE—VOLTAGE—CASE CODE TABLE

Select standard Capacitance/Voltage ratings and corresponding standard ULTRA CHIP case codes from this table.

CAP μF	PICOFARAD CODE*	004 V	006 V	010 V	015 V	020 V	025 V	035 V	050 V
0.10	104	A	A	A	A	A	A	A	A
0.15	154	A	A	A	A	A	A	A	A
0.22	224	A	A	A	A	A	A	A	B
0.33	334	A	A	A	A	A	A	B	B
0.47	474	A	A	A	A	A	B	B	C
0.68	684	A	A	A	A	B	B	C	
1.0	105	A	A	A	B	B	C		
1.5	155	A	A	B	B	C			
2.2	225	A	B	B	C				
3.3	335	B	B	C					
4.7	475	B	C						
6.8	685	C							

PHYSICAL SPECIFICATIONS

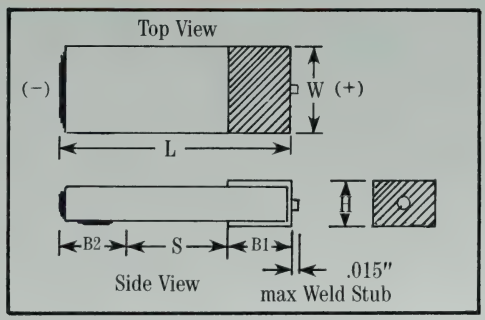
DIMENSIONS—Inches

CASE CODE	(W) WIDTH ±0.015	(L) LENGTH ±0.015	(H) HEIGHT ±0.015	(S) SPACING Typical	(B1) + PAD WIDTH ±0.010	(B2) − PAD WIDTH −.010/+.025
A	.050	.100	.050	.040	.030	.030
B	.050	.150	.050	.090	.030	.030
C	.050	.200	.050	.140	.030	.030

DIMENSIONS—mm

CASE CODE	(W) WIDTH +0.381	(L) LENGTH ±0.381	(H) HEIGHT ±0.381	(S) SPACING Typical	(B1) + PAD WIDTH ±0.254	(B2) − PAD WIDTH −.254/+.635
A	1.27	2.54	1.27	1.02	0.76	0.76
B	1.27	3.81	1.27	2.29	0.76	0.76
C	1.27	5.08	1.27	3.55	0.76	0.76

CASE OUTLINE DRAWING



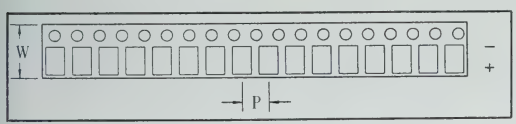
NOTES:

1. For polarity identification, when chip is in mounting position, bare metal clip and weld stub are positive. The top negative surface is conformally coated.
2. Metric Equivalents are for general information purposes only and are based on 1"=25.4 mm.
3. Anode Riser (Weld Stub) may extend case size Length dimension by 0.015" (.38 mm) max.
4. Spacing Dimension is typical distance between chip mounting terminations and therefore average distance between mounting pads on substrate.

PACKAGING

TAPE & REEL

■ 49UC Series capacitors are shipped in Tape & Reel packaging to facilitate the use of automatic placement equipment. Tape & Reel is per EIA (Electronic Industries Association) specification RS-481A. Capacitor orientation within tape pockets is negative terminal toward sprocket holes and mounting side down. 8 and 12 mm tape widths are used according to case size. Quantities less than minimum reel will be shipped in Blister Pack trays.

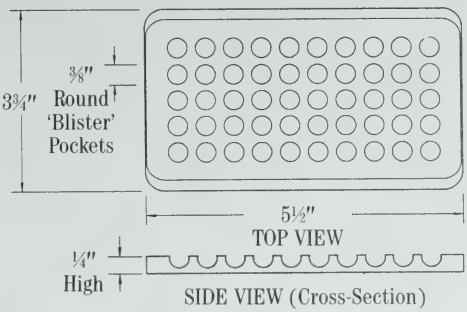


TAPE & REEL SPECIFICATIONS

49UC Case Code	(W) Tape Width	(P) Unit Pitch Ctr/Ctr	Quantity per full 7" Reel	Minimum Quantity per Reel
A	8 mm	4 mm	3,000	1,500
B	12 mm	4 mm	3,000	1,500
C	12 mm	4 mm	3,000	1,500

BLISTER-PACK TRAYS

■ 49UC Series capacitors are available in 'Blister Pack' trays containing 50 pieces each in a 5 x 10 matrix configuration. The Blister Pack provides a separate pocket for each unit to prevent damage to the capacitors during shipping, handling and storage.



■ Blister Pack trays are stamped polystyrene with a clear plastic cover. Orientation of the capacitors within the pockets is random with respect to polarity and mounting surface. This packaging is ideal for hand placement of the capacitors as it takes up very little room at a work station. It is recommended that operators remove and work with the ULTRA CHIPs using a blunt, coated tweezer to prevent damage to the conformal coating.

APPLICATION NOTES

CAPACITANCE

■ Capacitance shall be measured at or referred to 120 Hz at 25°C. The AC signal shall not exceed 1.0 VRMS.

■ TOLERANCE—Type 49UC are available in ±20%, ±10% and ±5% capacitance tolerances.

■ CAPACITANCE CHANGE WITH TEMPERATURE—from 25°C reading (maximum):
at −55°C −10% Δ
at +85°C +10% Δ
at +125°C +15% Δ

DISSIPATION FACTOR (DF)

■ DF is determined by the same method as capacitance.

DC LEAKAGE CURRENT (DCL)

■ DCL shall be measured at WVDC after a 5 minute electrification period with a 1000 ohm current-limiting resistor in series.

VOLTAGE RATING

■ ULTRA CHIPS can be used at elevated temperatures when voltage is derated in accordance with the following:

Rated WVDC −55°C to 85°C	Derated (DC) 125°C	Surge Voltage (DC) 85°C	Surge Voltage (DC) 125°C
4	2.7	5.0	3.4
6	4.0	8.0	5.0
10	7.0	13.0	9.0
15	10.0	20.0	12.0
20	13.0	26.0	16.0
25	17.0	32.0	20.0
35	23.0	46.0	26.0
50	33.0	65.0	38.0

SURGE VOLTAGE

■ The surge voltage is the maximum DC voltage, including AC or other pulses applied for short duration.

REVERSE VOLTAGE

■ Series 49UC capacitors will withstand momentary voltage reversals up to 15% at 25°C, 10% at 55°C and 1% at 125°C of their rated voltage.

ULTRA CHIP ELECTRICAL LIMITS & CASE CODES

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	DC Leakage (max) 85°C µA	DC Leakage (max) 125°C µA	DF 120Hz %	ESR (max)* 120Hz Ω	ESR (max)* 100KHz Ω	Case Code
2.2	4	0.5	5	7	6	36	9.0	A
4.7	4	0.5	5	7	6	17	5.5	B
6.8	4	0.5	5	7	6	12	3.5	C
1.5	6	0.5	5	7	6	53	9.0	A
3.3	6	0.5	5	7	6	24	5.5	B
4.7	6	0.5	5	7	6	17	3.5	C
1.0	10	0.5	5	7	6	80	9.0	A
2.2	10	0.5	5	7	6	36	5.5	B
3.3	10	0.5	5	7	6	24	3.5	C
.68	15	0.5	5	7	6	120	10.0	A
1.5	15	0.5	5	7	6	53	6.0	B
2.2	15	0.5	5	7	6	36	4.0	C
.47	20	0.5	5	7	6	170	12.0	A
.68	20	0.5	5	7	6	120	8.0	B
1.0	20	0.5	5	7	6	80	8.0	B
1.5	20	0.5	5	7	6	53	6.0	C
.33	25	0.5	5	7	6	240	15.0	A
.68	25	0.5	5	7	6	120	10.0	B
1.0	25	0.5	5	7	6	80	8.0	C
.22	35	0.5	5	7	6	360	18.0	A
.47	35	0.5	5	7	6	170	12.0	B
.68	35	0.5	5	7	6	120	9.0	C
.10	50	0.5	5	7	6	800	20.0	A
.15	50	0.5	5	7	6	530	20.0	A
.22	50	0.5	5	7	6	360	15.0	B
.33	50	0.5	5	7	6	240	15.0	B
.47	50	0.5	5	7	6	170	10.0	C

*120 Hz ESR is maximum at nominal capacitance.

MARKING

■ The small physical size of the ULTRA CHIP does not permit alpha-numeric marking on the body of the capacitor. Color dots on the body of the capacitor are available on special order, if required. Series 49UC capacitors are identified in their package container.

POLARITY

■ Series 49UC capacitors are polar devices. Proper polarity must be observed or damage to the capacitor and/or the circuit will result.

AC POWER DISSIPATION

CASE CODE	MAXIMUM POWER DISSIPATION IN WATTS AMBIENT TEMPERATURE		
	25°C	85°C	125°C
A	.063	.056	.025
B	.075	.067	.030
C	.081	.073	.032

■ Major physical factors which limit the ability of the capacitor to dissipate internally generated heat produced during AC circuit operation, include unit construction features as related to a particular capacitor design, and heat transfer characteristics of the materials used in the construction of the capacitor. Larger volumetric packages exhibiting electrical characteristics similar to those of smaller physical packages will, under similar conditions, be capable of dissipating more power. Conformally coated capacitors, such as the ULTRA CHIP series, exhibit more efficient heat dissipation capabilities, due to the absence of relatively thick thermally insulative coatings, as incorporated in "molded" tantalum chip capacitor styles.

■ Maximum power dissipation levels shown represent an empirically determined wattage level required to cause a 10 degree centigrade temperature increase above the stated temperature in "still air" as measured on the external capacitor body, utilizing a thermo-couple or other appropriate measuring device.

AC RIPPLE CURRENT

■ Circuit design and physical layout should provide "cool" circuit board locations for capacitors operating at high AC current levels. Capacitor temperature may increase due to heat transfer/absorption from the ambient environment or a "hot" component mounted in close proximity to the capacitor. The result of increased AC current is increased internal heat generation within the capacitor body. Waveform envelope is also a factor in the amount of internal heat generated within the capacitor since non-sinusoidal waveshapes produce heating effects different than those of sinusoidal waveforms.

■ The ripple current and voltage level impressed across the capacitor should not exceed the maximum power dissipation of the capacitor unless special provisions are made to increase the rate of heat dissipation from the body of the capacitor, such as by the use of a heat sink or providing air flow. Excessive power dissipation in tantalum chip capacitors may cause catastrophic failure. The I_{max} value of current must be used to determine the operating conditions.

■ The maximum permissible AC (rms) current applied across the capacitor is related to the equivalent series resistance (ESR) and the physical power dissipation capability of the capacitor. The maximum (rms) ripple current at a given frequency may be determined by:

$$I_{max}\,(rms) = \sqrt{Pdm/ESR}$$

where...Pdm = Maximum Power Dissipation in watts, at the maximum circuit operating temperature

$$ESR = \frac{1}{2\pi * \text{AC Frequency} * \text{Capacitance}} * \text{D.F.}$$

AC Frequency in Hertz
Capacitance is in Farads
Dissipation Factor is in decimal form

AC RIPPLE VOLTAGE

■ The maximum AC ripple voltage at the applied frequency must be limited to an rms value which permits only the recommended maximum power dissipation specified for a given case code.

■ The maximum AC ripple voltage may be determined by:

$$E_r\,(rms) = Z\sqrt{Pdm/ESR}$$

where...E_r = AC Ripple Voltage
Z is the Impedance in ohms
Pdm is the Maximum Power Dissipation in watts, at the maximum circuit operating temperature
ESR is the Equivalent Series Resistance in ohms

■ Both voltage and current levels at a given frequency must be maintained so as not to exceed the recommended maximum power dissipation levels at the maximum circuit operating temperature. The DC bias voltage applied in series with the AC source applied across polar style capacitors, on which the AC voltage is "riding," may be ignored when considering the heating effects of AC current on the capacitor. The positive peak AC voltage plus the DC voltage must not exceed the rated DC voltage of the capacitor. The negative peak AC voltage in combination with the DC voltage may not obtain a level which will damage the dielectric due to reverse voltage being applied across a polar solid electrolyte tantalum chip capacitor.

NON-POLAR OPERATION

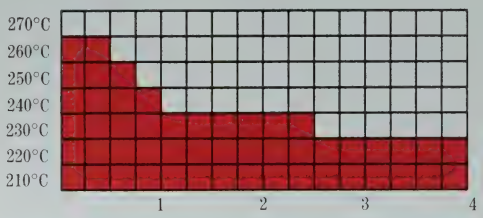
■ When two polar capacitors of the same DC voltage rating are connected back-to-back in non-polar configuration, i.e. positive-to-positive terminals or negative-to negative terminals; the "non-polar" pair may be operated without DC bias voltage. If DC voltage is applied, the positive peak AC voltage plus the DC voltage must not exceed the rated voltage of the capacitor in either direction.

SURFACE-MOUNT APPLICATION

■ ULTRA CHIP capacitors are ideally suited for use on SMD circuit boards where circuit density requires the use of components with the highest cap/unit volume efficiency. Current solder reflow techniques such as IR (Infra-Red), Wave Soldering and Vapor Phase may be utilized with these capacitors.

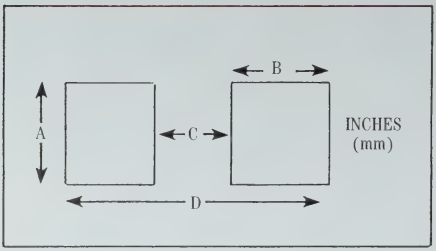
REFLOW TIMES and TEMPERATURES

The optimum reflow profile will include a preheat cycle to provide proper fluxing prior to reflow.



Recommended Maximum Time (Minutes)

RECOMMENDED PAD DIMENSIONS FOR REFLOW SOLDERING

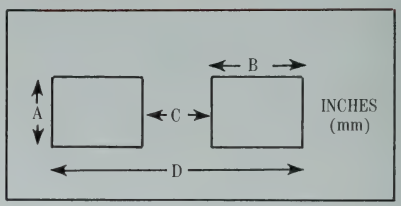


CASE SIZE	A MIN.	B MIN.	C NOM.	D NOM.
A	.085 (2.15)	.062 (1.58)	.030 (0.77)	.204 (5.17)
B	.085 (2.15)	.062 (1.58)	.080 (2.04)	.254 (6.44)
C	.085 (2.15)	.062 (1.58)	.130 (3.31)	.304 (7.71)

ADDITIONAL PHYSICAL STATISTICS

49UC Case Codes	PHYSICAL STATISTICS				Typical Weight (grams)
	Substrate Area		Typical Volume		
	sq. in.	sq. cm	cu. in.	cu. cm	
A	0.00500	0.0323	0.000250	0.0041	0.02
B	0.00750	0.0484	0.000375	0.0062	0.03
C	0.01000	0.0645	0.000500	0.0082	0.04

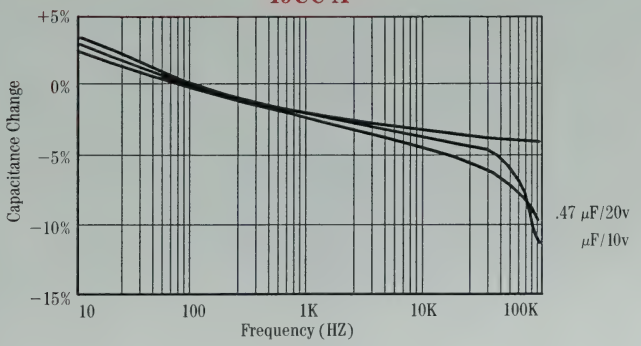
RECOMMENDED PAD DIMENSIONS FOR WAVE SOLDERING



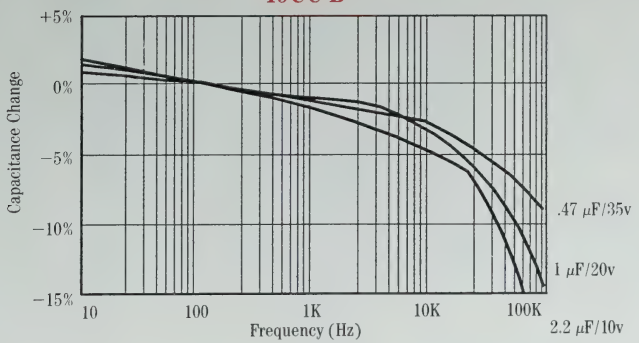
CASE SIZE	A MIN.	B MIN.	C NOM.	D NOM.
A	.044 (1.11)	.067 (1.70)	.030 (0.77)	.204 (5.17)
B	.044 (1.11)	.067 (1.70)	.080 (2.04)	.254 (6.44)
C	.044 (1.11)	.067 (1.70)	.130 (3.31)	.304 (7.71)

TYPICAL CHARACTERISTICS

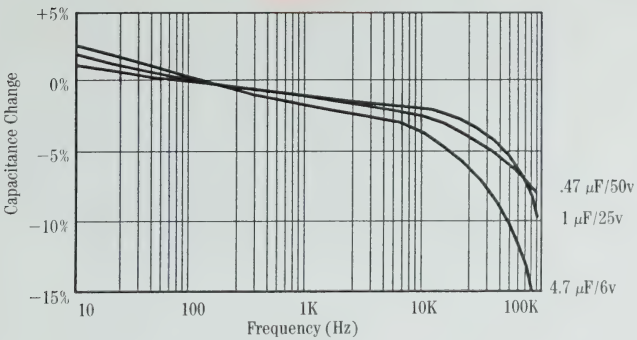
49UC-A



49UC-B

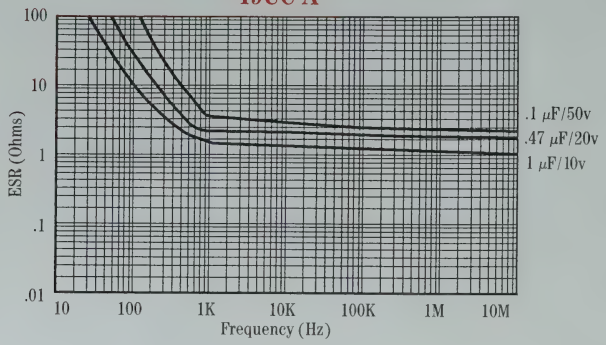


49UC-C

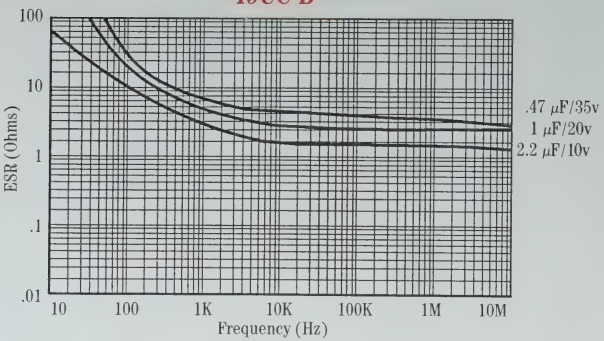


TYPICAL CHARACTERISTICS

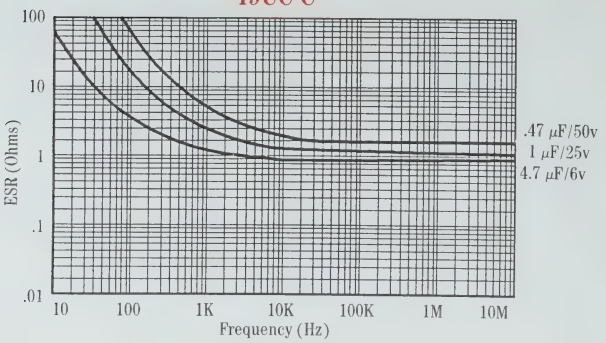
49UC-A



49UC-B



49UC-C



SERIES 49XC XTRA CHIP Tantalum SMD® (Chip) Capacitors

DESCRIPTION

■ The 49XC XTRA CHIP Series surface mounted tantalum chip capacitor offers the highest capacitance rating at a given rated voltage of any tantalum chip capacitor series currently available in the industry…a true state-of-the-art" product.

■ The 49XC Series tantalum chip capacitor is the most volumetric efficient tantalum chip capacitor available for printed wiring board or thick/thin film hybrid circuit applications. The 49XC tantalum chip capacitor requires as little as 1/7 (one-seventh) the volume required by commercially available molded tantalum chip capacitor series, for comparable capacitance-voltage (CV) ratings. This advanced series offers up to 4 times the capacitance currently available in other conformally coated tantalum chip capacitors of the same voltage rating and size.

■ The XTRA CHIP tantalum chip capacitor is available in five standard case sizes which are identical to the STAR CHIP tantalum chip capacitor and cover the capacitance range of 1.0 μF through 220 μF in the voltage range of 4 through 50 VDC.

■ The capacitive element of each XTRA CHIP tantalum chip capacitor is protected by a "near-hermetic" patented construction feature which provides total compatibility with all standard soldering fluxes, soldering methods and cleaning solvents. This construction also provides efficient ripple current heat dissipation in each of the five case sizes.

■ XTRA CHIP Surface Mount Devices are supplied in 12 mm embossed tape for efficiency in handling and storage. This packaging conforms to EIA standard RS-481 and is compatible with all tape-fed high speed placement equipment. cost.

■ Philips Components utilizes modern automated manufacturing processes incorporating Statistical Process Control (SPC) methods interacting with an integrated Manufacturing Resources Planning (MRP II) system to manufacture a very consistent and reliable product.

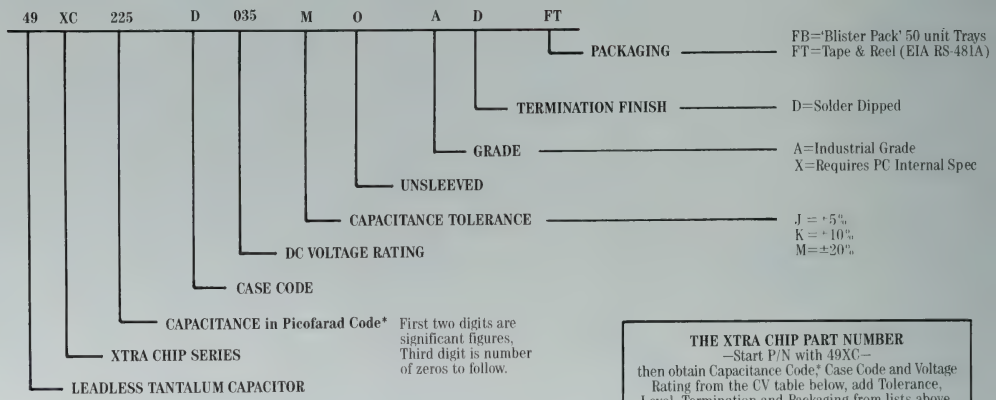
FEATURES

- −55°C through +85°C Operation (125°C with Voltage Derating)
- Capacitance Range: 1.0 μF to 220 μF
- Rated Voltages: 4 VDC to 50 VDC
- Five Standard Case Sizes: D, E, F, G, H
- Low ESR in High-Frequency Applications
- Solder-Dipped Terminations Ideally Suited for Solder Reflow Techniques
- Conformally Coated Construction Provides Minimum Height
- 12 mm Tape & Reel (Standard Packaging) Conforms to EIA RS-481 Specifications

"SMD is a Service Mark of North American Philips Corporation
The Xtra Chip is covered by US Patent No. 4,571,664

PART NUMBER DESIGNATION

Philips Components Series 49XC XTRA CHIP Capacitors can be completely specified using the following designation:



THE XTRA CHIP PART NUMBER
—Start P/N with 49XC—
then obtain Capacitance Code,* Case Code and Voltage Rating from the CV table below, add Tolerance, Level, Termination and Packaging from lists above.

49XC CAPACITANCE—VOLTAGE—CASE CODE TABLE

Select standard Capacitance-Voltage ratings and corresponding standard XTRA CHIP case codes from this table.

CAP μF	PICOFARAD CODE*	004 V	006 V	010 V	015 V	020 V	025 V	035 V	050 V
1.0	105	→	→	→	→	→	→	D	D
1.5	155	→	→	→	→	→	→	D	D
2.2	225	→	→	→	→	→	→	D	E
3.3	335	→	→	→	→	→	D	E	F
4.7	475	→	→	→	→	→	D	F	G
6.8	685	→	→	→	→	D	E	F	G
10	106	→	→	→	D	E	F	G	H
15	156	→	→	→	D	→	F	H	
22	226	→	→	D	→	F	G		
33	336	→	D	→	F	G	H		
47	476	→	E	F	G	H			
68	686	→	F	G	H				
100	107	F	G	H					
120	127	→	G	H					
150	157	→	G						
180	187	G	H						
220	227	H							

Arrow indicates that next higher voltage is the standard rating available.

PHYSICAL SPECIFICATIONS

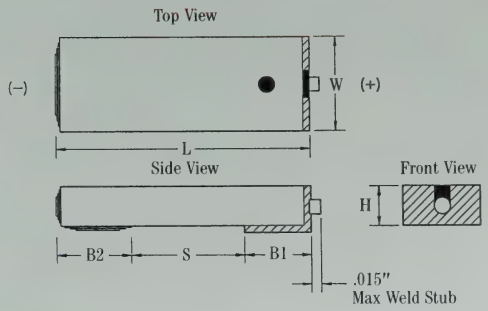
DIMENSIONS—Inches

CASE CODE	(W) WIDTH ±0.015	(L) LENGTH ±0.015	(H) HEIGHT ±0.015	(S) SPACING Typical	(B1) +PAD WIDTH ±0.010	(B2) −PAD WIDTH −.010/+.025
D	.100	.150	.050	.090	.030	.030
E	.100	.200	.050	.140	.030	.030
F	.135	.220	.070	.160	.030	.030
G	.110	.265	.110	.165	.050	.050
H	.160	.275	.110	.175	.050	.050

DIMENSIONS—mm

CASE CODE	(W) WIDTH ±0.381	(L) LENGTH ±0.381	(H) HEIGHT ±0.381	(S) SPACING Typical	(B1) +PAD WIDTH ±0.254	(B2) −PAD WIDTH −.254/+.635
D	2.54	3.81	1.27	2.29	0.76	0.76
E	2.54	5.08	1.27	3.56	0.76	0.76
F	3.43	5.59	1.78	4.06	0.76	0.76
G	2.79	6.73	2.79	4.19	1.27	1.27
H	4.06	6.99	2.79	4.45	1.27	1.27

CASE OUTLINE DRAWING



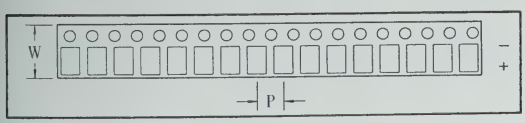
NOTES:

1. For polarity identification, when chip is in mounting position, metal "L" clip and weld stub are positive. The top negative surface is conformally coated.
2. Metric equivalents are for general information purposes only and are based on 1″=25.4 mm.
3. Anode riser (Weld Stub) may extend case size Length dimension by 0.015″ (.38 mm) max.
4. Spacing dimension is typical distance between chip mounting terminations and therefore average distance between mounting pads on substrate.

PACKAGING

TAPE & REEL

■ XTRA CHIP Series capacitors are shipped in Tape & Reel packaging to facilitate the use of automatic placement equipment. Tape & Reel is per EIA (Electronic Industries Association) specification RS 481. Orientation of the chip within the tape pockets is negative terminal toward sprocket holes and mounting side down. Quantities less than minimum reel will be shipped in Blister-Pack trays.

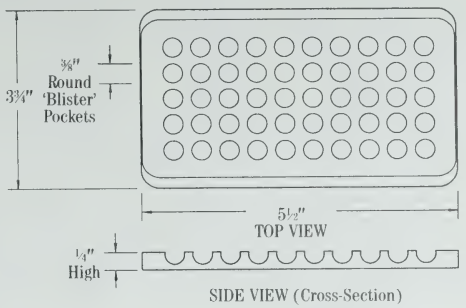


TAPE & REEL SPECIFICATIONS

CASE CODE	(W) Tape Width	(P) Unit Pitch Ctr/Ctr	Quantity per full 7″ Reel	Minimum Quantity per Reel
D	12mm	4mm	2,700	1,350
E	12mm	4mm	2,700	1,350
F	12mm	8mm	1,000	500
G	12mm	8mm	700	350
H	12mm	8mm	700	350

BLISTER-PACK TRAYS

■ 49XC Series capacitors are available in Blister-Pack trays containing 50 pieces each in a 5 x 10 matrix configuration. Blister Pack trays are stamped polystyrene with a clear plastic cover.



■ Orientation of the capacitors within the tray pockets is random with respect to polarity and mounting surface. This packaging is ideal for hand placement of the capacitors as it takes up very little room at the workstation.

APPLICATION NOTES

CAPACITANCE

■ Capacitance shall be measured at or referred to 120 Hz at 25°C. The AC signal shall not exceed 1.0 VRMS.

TOLERANCE: ±20%, ±10% and ±5% cap tolerances are available.

MAX CAPACITANCE CHANGE WITH TEMPERATURE from 25°C

Temperature	−55°C	+85°C	+125°C
Max. Cap Change	−10%△	+10%△	+15%△

DC LEAKAGE CURRENT (DCL)

■ DCL shall be measured at WVDC after a 5 minute electrification period with a 1000 ohm current-limiting resistor in series.

VOLTAGE RATING

■ All XTRA CHIP tantalum chip capacitors can be used at elevated temperatures when the working voltage is derated in accordance with the following table.

Rated WVDC −55°C to +85°C	Derated (DC) +125°C	Surge Voltage (DC) +85°C	Surge Voltage (DC) +125°C
4	2.7	5.0	3.4
6	4.0	8.0	5.0
10	7.0	13.0	9.0
15	10.0	20.0	12.0
20	13.0	26.0	16.0
25	17.0	32.0	20.0
35	23.0	46.0	26.0
50	33.0	65.0	38.0

XTRA CHIP ELECTRICAL LIMITS & CASE CODES

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	Dissipation Factor 25°C %	85°C 125°C	-55°C %	ESR (max) 100KHz Ω	Case Code
100	4	4.0	40	48	10	12	12	0.5	F
180	4	8.0	80	96	10	12	12	0.5	G
220	4	9.0	90	108	10	12	12	0.5	H
33	6	2.0	20	24	10	12	12	1.0	D
47	6	3.0	30	36	10	12	12	0.8	E
68	6	4.0	40	48	10	12	12	0.7	F
100	6	6.0	60	72	10	12	12	0.5	G
120	6	8.0	80	96	10	12	12	0.5	G
150	6	9.0	90	108	10	12	12	0.5	G
180	6	11.0	110	132	10	12	12	0.5	H
22	10	3.0	30	36	10	12	12	1.0	D
47	10	5.0	50	60	10	12	12	0.7	F
68	10	7.0	70	84	10	12	12	0.7	G
100	10	10.0	100	120	10	12	12	0.5	H
120	10	12.0	120	144	10	12	12	0.5	H
10	15	2.0	20	24	6	8	8	1.5	D
15	15	3.0	30	36	6	8	8	1.5	D
33	15	5.0	50	60	6	8	8	0.8	F
47	15	8.0	80	96	6	8	8	0.8	G
68	15	11.0	110	132	6	8	8	0.8	H
6.8	20	2.0	20	24	6	8	8	2.5	D
10	20	2.0	20	24	6	8	8	2.5	E
22	20	5.0	50	60	6	8	8	1.0	F

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	Dissipation Factor 25°C %	85°C 125°C	-55°C %	ESR (max) 100KHz Ω	Case Code
33	20	7.0	70	84	6	8	8	1.0	G
47	20	10.0	100	120	6	8	8	1.0	H
3.3	25	1.0	10	12	6	8	8	3.5	D
4.7	25	2.0	20	24	6	8	8	2.5	D
6.8	25	2.0	20	24	6	8	8	2.0	E
10	25	3.0	30	36	6	8	8	2.0	F
15	25	4.0	40	48	6	8	8	1.0	F
22	25	6.0	60	72	6	8	8	1.0	G
33	25	9.0	90	108	6	8	8	1.0	H
1.0	35	1.0	10	12	6	8	8	6.0	D
1.5	35	1.0	10	12	6	8	8	5.0	D
2.2	35	1.0	10	12	6	8	8	5.0	D
3.3	35	2.0	20	24	6	8	8	2.5	E
4.7	35	2.0	20	24	6	8	8	2.5	F
6.8	35	3.0	30	36	6	8	8	2.0	F
10	35	4.0	40	48	6	8	8	2.0	G
15	35	6.0	60	72	6	8	8	2.0	H
1.0	50	1.0	10	12	6	8	8	6.0	D
1.5	50	1.0	10	12	6	8	8	5.0	D
2.2	50	2.0	20	24	6	8	8	3.5	E
3.3	50	2.0	20	24	6	8	8	2.5	F
4.7	50	3.0	30	36	6	8	8	2.5	G
6.8	50	4.0	40	48	6	8	8	2.5	G
10	50	5.0	50	60	6	8	8	2.5	H

APPLICATION NOTES

AC POWER DISSIPATION

CASE CODE	MAXIMUM POWER DISSIPATION IN WATTS AMBIENT TEMPERATURE		
	+25°C	+85°C	+125°C
D	.095	.085	.038
E	.100	.090	.040
F	.125	.112	.050
G	.150	.135	.060
H	.200	.180	.080

■ Major physical factors which limit the ability of the capacitor to dissipate internally generated heat produced during AC circuit operation, include unit construction features as related to a particular capacitor design, and heat transfer characteristics of the materials used in the construction of the capacitor. Larger volumetric packages exhibiting electrical characteristics similar to those of smaller physical packages will, under similar conditions, be capable of dissipating more power. Conformally coated capacitors, such as the XTRA CHIP series tantalum chip capacitor, exhibit more efficient heat dissipation capabilities, due to the absence of relatively thick thermally insulative coatings, as incorporated in "molded" tantalum chip capacitor styles.

■ Maximum power dissipation levels shown represent an empirically determined wattage level required to cause a 10 degree centigrade temperature increase above the stated temperature in "still air" as measured on the external capacitor body, utilizing a thermo-couple or other appropriate measuring device.

AC RIPPLE CURRENT

■ Circuit design and physical layout should provide "cool" circuit board locations for capacitors operating at high AC current levels. Capacitor temperature may increase due to heat transfer or absorption from the ambient environment or a "hot" component mounted in close proximity to the capacitor. The result of increased AC current is increased internal heat generation within the capacitor body. Waveform envelope is also a factor in the amount of internal heat generated within the capacitor since non-sinusoidal waveshapes produce heating effects different than those of sinusoidal waveforms.

■ The ripple current and voltage level impressed across the capacitor should not exceed the maximum power dissipation of the capacitor unless special provisions are made to increase the rate of heat dissipation from the body of the capacitor, such as by the use of a heat sink or providing air flow. Excessive power dissipation in tantalum chip capacitors may cause catastrophic failure. The I_{max} value of current must be used to determine the operating conditions.

■ The maximum permissible AC (rms) current applied across the capacitor is related to the equivalent series resistance (ESR) and the physical power dissipation capability of the capacitor. The maximum (rms) ripple current at a given frequency may be determined by:

$$I_{max}\,(rms) = \sqrt{Pdm/ESR}$$

where... Pdm=Maximum Power Dissipation in watts, at the maximum circuit operating temperature

$$ESR = \frac{D.F.}{2\pi * \text{AC Frequency} * \text{Capacitance}}$$

AC Frequency is in Hertz
Capacitance is in Farads
Dissipation Factor is in decimal form

AC RIPPLE VOLTAGE

■ The maximum AC ripple voltage at the applied frequency must be limited to an rms value which permits only the recommended maximum power dissipation specified for a given case code. The maximum AC ripple voltage may be determined by:

$$E_r\,(rms) = Z\sqrt{Pdm/ESR}$$

where... E_r=AC Ripple Voltage
Z is the Impedance in ohms
Pdm is the Maximum Power Dissipation in watts, at the maximum circuit operating temperature
ESR is the Equivalent Series Resistance in ohms

■ Both voltage and current levels at a given frequency must be maintained so as not to exceed the recommended maximum power dissipation levels at the maximum circuit operating temperature. The DC bias voltage applied in series with the AC source applied across polar style capacitors, on which the AC voltage is "riding," may be ignored when considering the heating effects of AC current on the capacitor. The positive peak AC voltage plus the DC voltage must not exceed the rated DC voltage of the capacitor. The negative peak AC voltage in combination with the DC voltage may not obtain a level which will damage the dielectric due to reverse voltage being applied across a polar solid electrolyte tantalum chip capacitor.

SURGE VOLTAGE

■ The surge voltage is the maximum DC voltage, including AC or other pulses applied for short duration.

REVERSE VOLTAGE

■ Series 49XC hybrid capacitor will withstand momentary voltage reversals up to 15% at 25°C, 10% at 55°C and 1% at 125°C of the capacitor's rated voltage.

POLARITY

■ Series 49XC capacitors are polar devices. Proper polarity must be observed or damage to the capacitor and/or the circuit will result. The positive end is marked with a dot or stripe.

APPLICATION NOTES

MARKING

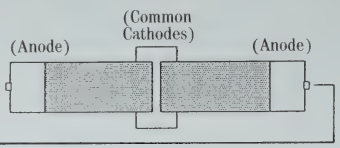
■ The small physical size of the XTRA CHIP capacitor does not permit alpha-numeric marking on the body of the capacitor. Color dots on the body of the capacitor are available on special order, if required. Series 49XC capacitors are identified on their package container.

NON-POLAR OPERATION

■ When two polar capacitors of the same DC voltage rating are connected back-to-back in non-polar configuration, i.e. positive-to-positive terminals or negative-to-negative terminals; the "non-polar" pair may be operated without DC bias voltage. If DC voltage is applied, the positive peak AC voltage plus the DC voltage must not exceed the rated voltage of the capacitor in either direction. In circuits where voltage reversals exceeding 15% at 25°C occur, or where AC ripple voltages are high, XTRA CHIP capacitors should be mounted in a non-polar configuration.

■ In these cases, if two identical XTRA CHIP capacitors are mounted in this fashion, the resulting capacitance will be ½ the value of the original devices and the voltage will be the same as the rating of the original devices.

Non-Polar Operation
Voltage dropped across anodes of capacitors in non-polar configuration (cathodes tied together).

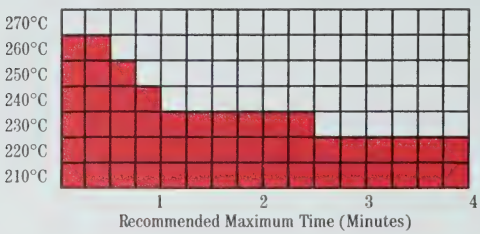


SURFACE-MOUNT APPLICATION

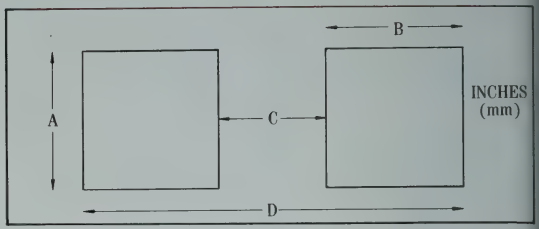
■ XTRA CHIP capacitors are ideally suited for use on SMD circuit boards where circuit density requires the use of components with the highest cap/unit volume efficiency. Current solder reflow techniques such as IR (Infra-Red), Wave Soldering and Vapor Phase may be utilized with these capacitors.

REFLOW TIMES AND TEMPERATURES

■ The optimum reflow profile will include a preheat cycle to provide proper fluxing prior to reflow.

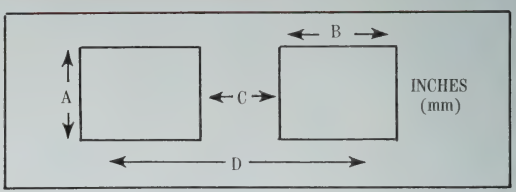


RECOMMENDED PAD DIMENSIONS FOR REFLOW SOLDERING



CASE SIZE	A MIN.	B MIN.	C NOM.	D NOM.
D	.135 (3.42)	.062 (1.58)	.080 (2.04)	.254 (6.44)
E	.135 (3.42)	.062 (1.58)	.130 (3.31)	.304 (7.71)
F	.170 (4.31)	.062 (1.58)	.150 (3.82)	.324 (8.22)
G	.145 (3.67)	.082 (2.08)	.155 (3.94)	.369 (9.36)
H	.195 (4.94)	.082 (2.08)	.165 (4.20)	.379 (9.62)

RECOMMENDED PAD DIMENSIONS FOR WAVE SOLDERING



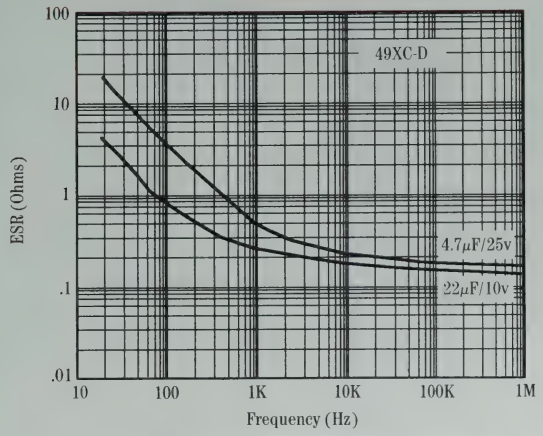
CASE SIZE	A MIN.	B MIN.	C NOM.	D NOM.
D	.077 (1.96)	.067 (1.70)	.080 (2.04)	.254 (6.44)
E	.077 (1.96)	.067 (1.70)	.130 (3.31)	.304 (7.71)
F	.101 (2.55)	.067 (1.70)	.150 (3.81)	.324 (8.22)
G	.084 (2.13)	.087 (2.21)	.155 (3.94)	.369 (9.36)
H	.117 (2.98)	.087 (2.21)	.165 (4.20)	.379 (9.62)

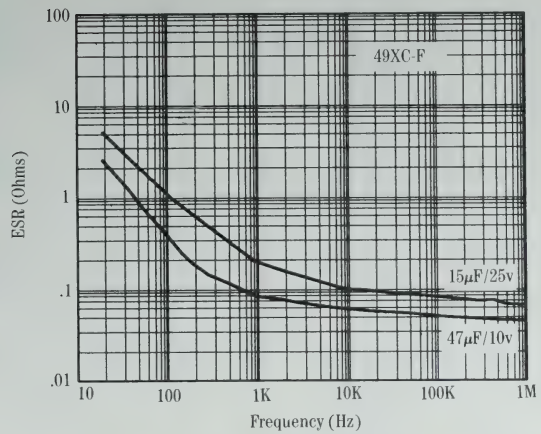
ADDITIONAL PHYSICAL STATISTICS

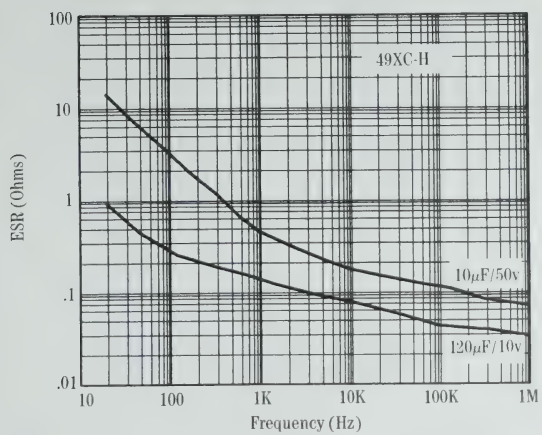
PHYSICAL STATISTICS					Typical Weight (grams)
CASE CODE	Substrate Area sq. in.	sq. cm	Typical Volume cu. in.	cu. cm	
D	0.01500	0.0967	0.000750	0.0123	0.07
E	0.02000	0.1290	0.001000	0.0164	0.09
F	0.02970	0.1917	0.002079	0.0341	0.18
G	0.02915	0.1878	0.003200	0.0524	0.27
H	0.04560	0.2944	0.005060	0.0821	0.44

APPLICATIONS GUIDELINES

EQUIVALENT SERIES RESISTANCE vs FREQUENCY

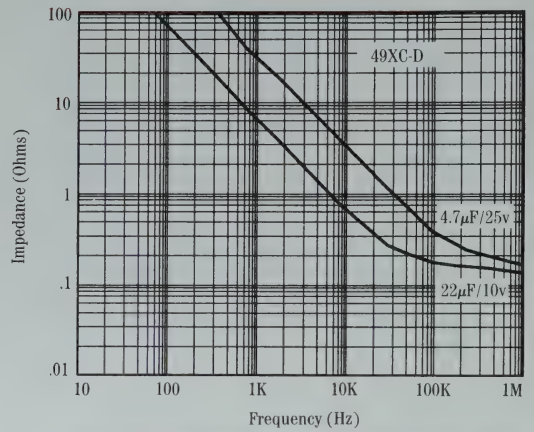


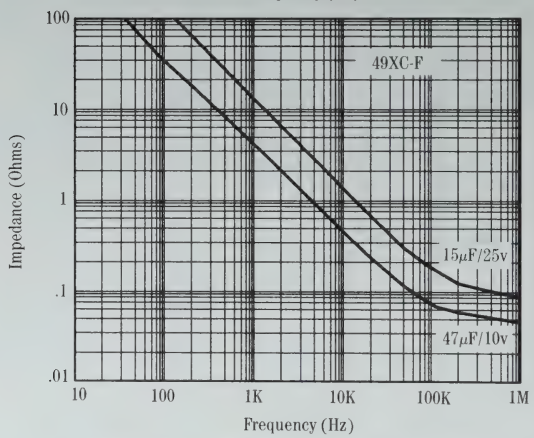


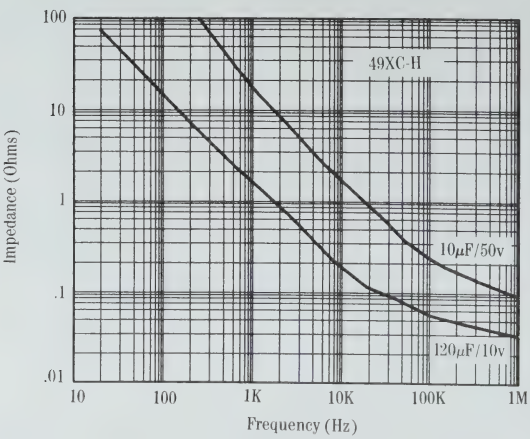


APPLICATIONS GUIDELINES

IMPEDANCE vs FREQUENCY







SERIES 49MC MOLDED CHIP Tantalum SMD® (Chip) Capacitors

DESCRIPTION

- The 49MC is a molded chip capacitor designed specifically for high volume surface mount applications where handling with high-speed pick and place equipment is required.
- The MOLDED CHIP construction protects the internal capacitor element from external contaminants and is totally compatible with the standard reflow soldering and cleaning methods encountered during SMT manufacturing.
- The 49MC series product is available in four standard case sizes which conform to the EIA/U.S. Manufacturer's Standard for Tantalum Chip Capacitors.
- The Philips MOLDED CHIP is ideally suited for use on circuit boards where cap values between 0.1 μF and 100 μF are required.
- The molded construction provides total uniformity of size and flat surfaces required for automatic chip placement.
- The MOLDED CHIP is also available in the military established reliability MIL-C-55365/8 Style CWR11 for use in military SMT electronic circuit designs. The CWR11 style MOLDED CHIPs maintain qualification to Exponential Failure Rate Level "P".
- Philips utilizes the most modern manufacturing processes coupled with Statistical Process Control methods (SPC) and an integrated Manufacturing Resources Planning system (MRP II) to provide a very consistent and reliable product for either small or large volume usages.

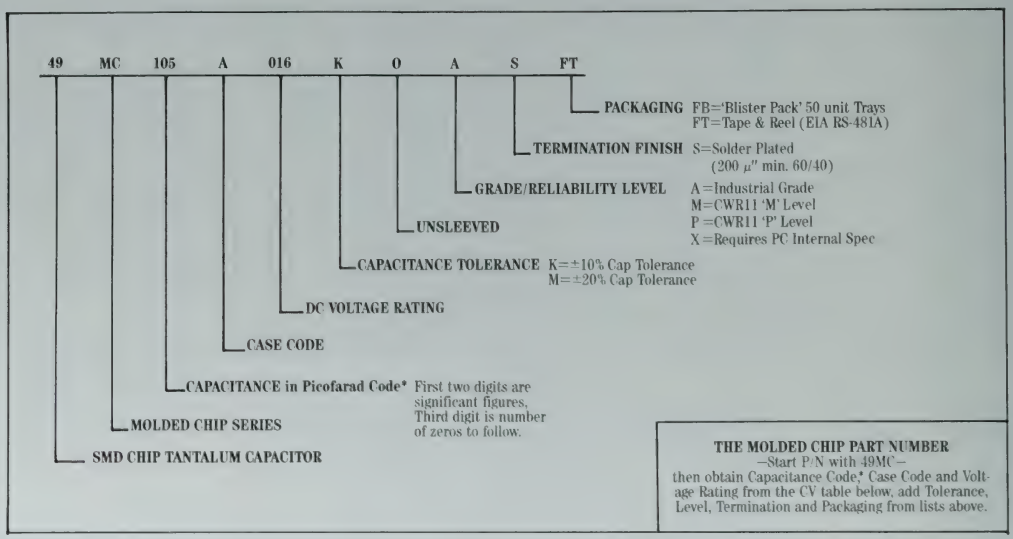
FEATURES

- 4 Standard Physical Case Sizes which conform to the EIA/U.S. Manufacturer's Standard EIA-535BAAC for Tantalum Chip Capacitors (formerly EIA IS-28)
- −55°C through +85°C Operation (125°C with Voltage Derating)
- Capacitance Range: 0.1 μF to 100 μF
- Rated Voltages: 4 VDC to 50 VDC
- Qualification to MIL-C-55365/8 Style CWR11 Exponential Failure Rate Level "P"
- Standard Electro-Plated Tin/Lead Terminations are suited for most Solder Reflow applications
- Tape & Reel Packaging per EIA Specification RS-481

*SMD is a Service Mark of North American Philips Corporation

PART NUMBER DESIGNATION

Philips Components Series 49MC Molded Chip Capacitors can be completely specified using the following designation:


49 MC 105 A 016 K 0 A S FT
PACKAGING FB='Blister Pack' 50 unit Trays
FT=Tape & Reel (EIA RS-481A)
TERMINATION FINISH S=Solder Plated
(200 μ" min. 60/40)
GRADE/RELIABILITY LEVEL A=Industrial Grade
M=CWR11 'M' Level
P=CWR11 'P' Level
X=Requires PC Internal Spec
UNSLEEVED
CAPACITANCE TOLERANCE K=±10% Cap Tolerance
M=±20% Cap Tolerance
DC VOLTAGE RATING
CASE CODE
CAPACITANCE in Picofarad Code* First two digits are significant figures. Third digit is number of zeros to follow.
MOLDED CHIP SERIES
SMD CHIP TANTALUM CAPACITOR
THE MOLDED CHIP PART NUMBER
—Start P/N with 49MC—
then obtain Capacitance Code,* Case Code and Voltage Rating from the CV table below, add Tolerance, Level, Termination and Packaging from lists above.

PHYSICAL SPECIFICATIONS

DIMENSIONS—Inches

CASE CODE		(L)	(W)	(H)	(B)	(S)	TAB DIMENSIONS	
EIA	49MC	LENGTH	WIDTH	HEIGHT	PAD WIDTH	min	(W2) min-max	(H2)
3216	A	.126 ± .008	.063 ± .008	.071 max	.031 ± .012	.031	.043-.051	.028 min
3528	B	.138 ± .008	.110 ± .008	.083 max	.031 ± .012	.043	.083-.091	.028 min
6032	C	.236 ± .012	.126 ± .012	.110 max	.051 ± .012	.098	.083-.091	.039 min
7343	D	.287 ± .012	.169 ± .012	.122 max	.051 ± .012	.149	.091-.098	.039 min

DIMENSIONS—mm

CASE CODE		(L)	(W)	(H)	(B)	(S)	TAB DIMENSIONS	
EIA	49MC	LENGTH	WIDTH	HEIGHT	PAD WIDTH	min	(W2) min-max	(H2)
3216	A	3.2 ± 0.2	1.6 ± 0.2	1.8 max	0.8 ± 0.3	0.8	1.1-1.3	0.7 min
3528	B	3.5 ± 0.2	2.8 ± 0.2	2.1 max	0.8 ± 0.3	1.1	2.1-2.3	0.7 min
6032	C	6.0 ± 0.3	3.2 ± 0.3	2.8 max	1.3 ± 0.3	2.5	2.1-2.3	1.0 min
7343	D	7.3 ± 0.3	4.3 ± 0.3	3.1 max	1.3 ± 0.3	3.8	2.3-2.5	1.0 min

49MC CAPACITANCE–VOLTAGE–CASE CODE TABLE

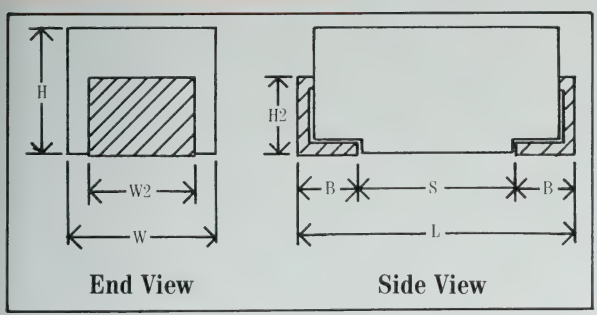
Select standard Capacitance/Voltage ratings and corresponding standard Molded Chip case codes from this table.

CAP µF	PICOFARAD CODE	004 V	006 V	01 V	016 V	020 V	025 V	035 V	050 V
0.10	104	→	→	→	→	→	→	A	A
0.15	154	→	→	→	→	→	→	A	B
0.22	224	→	→	→	→	→	→	A	B
0.33	334	→	→	→	→	→	→	A	B
0.47	474	→	→	→	→	→	A	B	C
0.68	684	→	→	→	→	A	→	B	C
1.0	105	→	→	→	A	A*	→	B	C
1.5	155	→	→	A	A*	→	B	C	D
2.2	255	→	A	A*	→	B	→	C	D
3.3	335	A	A*	→	B	B*	C	C*	D
4.7	475	A*	→	B	B*	C	C*	D	D
6.8	685	→	B	B*	C	C*	D	D	
10.0	685	B	B*	C	C*	→	D	D*	
15.0	156	B*	C	C*	→	D	D*		
22.0	226	C	C	→	D	D*			
33.0	336	C	→	D	D*				
47.0	476	→	D	D*					
68.0	686	D	D						
100.0	107	D	D*						

Arrow indicates that next higher voltage is the standard rating available. Units will be marked with the highest voltage available for that case and capacitance rating. Devices rated at 6.3 volts will be marked 6 volts.

***Indicates increased CV rating.**

CASE OUTLINE DRAWING



APPLICATION NOTES

CAPACITANCE—DISSIPATION FACTOR

■ Capacitance shall be measured at or referred to 120 Hz at 25°C. Maximum DC bias is 2.2 V. AC signal shall not exceed 1.0 VRMS.

■ TOLERANCE—Available in 20%, and 10% cap tolerances.

■ CAPACITANCE CHANGE WITH TEMPERATURE—from 25°C readings (maximum change):
at −55°C −10% Δ
at +85°C +10% Δ
at 125°C +12% Δ

DISSIPATION FACTOR (DF)

■ DF is determined by the same method as capacitance.

DC LEAKAGE CURRENT (DCL)

■ DCL shall be measured at WVDC after a 5 minute electrification period with a 1000 ohm current-limiting resistor in series.

VOLTAGE RATING

■ All MOLDED CHIPS can be used at elevated temperatures when the working voltage is derated in accordance with the following table:

Rated WVDC −55°C to 85°C	Derated (DC) 125°C	Surge Voltage (DC) 85°C	125°C
4	2.5	5.0	3.4
6.3	4.0	8.0	5.0
10	6.3	13.0	9.0
16	10.0	20.0	12.0
20	13.0	26.0	16.0
25	16.0	32.0	20.0
35	23.0	46.0	26.0
50	33.0	65.0	38.0

SURGE VOLTAGE

■ The surge voltage is the maximum DC voltage, including AC or other pulses applied for short duration.

REVERSE VOLTAGE

■ Series 49MC MOLDED CHIP capacitors will withstand momentary voltage reversals up to 15% of their rated voltages at 25°C, 10% at 55°C, 5% at 85°C and 1% at 125°C.

MOLDED CHIP ELECTRICAL LIMITS & CASE CODES

Cap. (nom) μF	Rated VDC 85°C	DC Leakage (max) 25°C μA	85°C μA	125°C μA	DF (max) 120Hz %	ESR (max) 100KHz Ω	Case Code
3.3	4	0.5	5	6.0	6	20.0	A
4.7	4	0.5	5	6.0	6	20.0	A
10	4	0.5	5	6.0	6	4.5	B
15	4	0.6	6	7.2	6	4.5	B
22	4	0.9	9	10.8	6	3.0	C
33	4	1.3	13	15.6	6	2.5	C
100	4	4.0	40	48	8	1.5	D
2.2	6.3	0.5	5	6.0	6	15.0	A
3.3	6.3	0.5	5	6.0	6	15.0	A
6.8	6.3	0.5	5	6.0	6	4.5	B
10	6.3	0.6	6	7.2	6	4.5	B
22	6.3	1.4	14	16.8	6	2.5	C
68	6.3	4.1	41	49.2	6	1.5	D
100	6.3	6.0	60	72.0	8	1.5	D
1.5	10	0.5	5	6.0	6	15.0	A
2.2	10	0.5	5	6.0	6	15.0	A
4.7	10	0.5	5	6.0	6	4.5	B
6.8	10	0.7	7	8.4	6	4.5	B
15	10	1.5	15	18.0	6	2.5	C
47	10	4.7	47	56.4	6	1.5	D
1.0	16	0.5	5	6.0	4	15.0	A
1.5	16	0.5	5	6.0	6	15.0	A
3.3	16	0.6	6	7.2	6	5.0	B
4.7	16	0.8	8	9.6	6	5.0	B
6.8	16	1.1	11	13.2	6	3.0	C
10	16	1.6	16	19.2	6	2.5	C
33	16	5.3	53	63.6	6	1.5	D
.68	20	0.5	5	6.0	4	15.0	A
1.0	20	0.5	5	6.0	4	15.0	A
2.2	20	0.5	5	6.0	6	6.0	B
3.3	20	0.7	7	8.4	6	6.0	B

Cap. (nom) μF	Rated VDC 85°C	DC Leakage (max) 25°C μA	85°C μA	125°C μA	DF (max) 120Hz %	ESR (max) 100KHz Ω	Case Code
4.7	20	1.0	10	12.0	6	3.0	C
6.8	20	1.4	14	16.8	6	2.5	C
22	20	4.4	44	52.8	6	1.5	D
.47	25	0.5	5	6.0	4	18.0	A
1.5	25	0.5	5	6.0	6	7.0	B
3.3	25	0.9	9	10.8	6	4.0	C
4.7	25	1.2	12	14.4	6	3.0	C
10	25	2.5	25	30.0	6	2.0	D
15	25	3.8	38	45.6	6	1.5	D
.10	35	0.5	5	6.0	4	24.0	A
.15	35	0.5	5	6.0	4	21.0	A
.22	35	0.5	5	6.0	4	19.0	A
.33	35	0.5	5	6.0	4	18.0	A
.47	35	0.5	5	6.0	4	11.0	B
.68	35	0.5	5	6.0	4	8.0	B
1.0	35	0.5	5	6.0	6	7.0	B
1.5	35	0.5	5	6.0	6	6.0	C
2.2	35	0.8	8	9.6	6	4.0	C
3.3	35	1.2	12	14.4	6	3.0	C
4.7	35	1.7	17	20.4	6	2.5	D
6.8	35	2.4	24	28.8	6	2.0	D
10	35	3.5	35	42.0	6	1.5	D
.10	50	0.5	5	6.0	4	22.0	A
.15	50	0.5	5	6.0	4	19.0	B
.22	50	0.5	5	6.0	4	16.0	B
.33	50	0.5	5	6.0	4	13.0	B
.47	50	0.5	5	6.0	4	9.0	C
.68	50	0.5	5	6.0	4	7.0	C
1.0	50	0.5	5	6.0	4	6.0	C
1.5	50	0.8	8	9.6	6	5.0	D
2.2	50	1.1	11	13.2	6	3.5	D
3.3	50	1.7	17	20.4	6	2.0	D
4.7	50	2.4	24	28.8	6	1.5	D

AC POWER DISSIPATION

CASE CODE	MAXIMUM POWER DISSIPATION IN WATTS AMBIENT TEMPERATURE		
	25°C	85°C	125°C
A	.075	.067	.030
B	.085	.077	.035
C	.110	.100	.045
D	.150	.135	.060

■ Major physical factors which limit the ability of the capacitor to dissipate internally generated heat produced during AC circuit operation, include unit construction features as related to a particular capacitor design, and heat transfer characteristics of the materials used in the construction of the capacitor. Larger volumetric packages exhibiting electrical characteristics similar to those of smaller physical packages will, under similar conditions, be capable of dissipating more power.

■ Maximum power dissipation levels shown represent an empirically determined wattage level required to cause a 10 degree centigrade temperature increase above the stated temperature in "still air" as measured on the external capacitor body, utilizing a thermo-couple or other appropriate measuring device.

AC RIPPLE CURRENT

■ Circuit design and physical layout should provide "cool" circuit board locations for capacitors operating at high AC current levels. Capacitor temperature may increase due to heat transfer/absorption from the ambient environment or a "hot" component mounted in close proximity to the capacitor. The result of increased AC current is increased internal heat generation within the capacitor body. Waveform envelope is also a factor in the amount of internal heat generated within the capacitor since non-sinusoidal waveshapes produce heating effects different from those of sinusoidal waveforms.

■ The ripple current and voltage level impressed across the capacitor should not exceed the maximum power dissipation of the capacitor unless special provisions are made to increase the rate of heat dissipation from the body of the capacitor, such as by the use of a heat sink or providing air flow. Excessive power dissipation in tantalum chip capacitors may cause catastrophic failure. The I_{max} value of current must be used to determine the operating conditions.

■ The maximum permissible AC (rms) current applied across the capacitor is related to the equivalent series resistance (ESR) and the physical power dissipation capability of the capacitor. The maximum (rms) ripple current at a given frequency may be determined by:

$$I_{max}\,(rms) = \sqrt{Pdm/ESR}$$

where...Pdm = Maximum Power Dissipation in watts, at the maximum circuit operating temperature

$$ESR = \frac{1}{2\pi * \text{AC Frequency} * \text{Capacitance}} * \text{D.F.}$$

AC Frequency in Hertz
Capacitance is in Farads
Dissipation Factor is in decimal form

AC RIPPLE VOLTAGE

■ The maximum AC ripple voltage at the applied frequency must be limited to an rms value which permits only the recommended maximum power dissipation specified for a given case code.

■ The maximum AC ripple voltage may be determined by:

$$E_r\,(rms) = Z\sqrt{Pdm/ESR}$$

where...E_r = AC Ripple Voltage
Z is the Impedance in ohms
Pdm is the Maximum Power Dissipation in watts, at the maximum circuit operating temperature
ESR is the Equivalent Series Resistance in ohms

■ Both voltage and current levels at a given frequency must be maintained so as not to exceed the recommended maximum power dissipation levels at the maximum circuit operating temperature. The DC bias voltage applied in series with the AC source applied across polar style capacitors, on which the AC voltage is "riding," may be ignored when considering the heating effects of AC current on the capacitor. The positive peak AC voltage plus the DC voltage must not exceed the rated DC voltage of the capacitor. The negative peak AC voltage in combination with the DC voltage may not obtain a level which will damage the dielectric due to reverse voltage being applied across a polar solid electrolyte tantalum chip capacitor.

NON-POLAR OPERATION

■ When two polar capacitors of the same DC voltage rating are connected back-to-back in non-polar configuration, i.e. positive-to-positive terminals or negative-to-negative terminals; the "non-polar" pair may be operated without DC bias voltage. If DC voltage is applied, the positive peak AC voltage plus the DC voltage must not exceed the rated voltage of the capacitor in either direction.

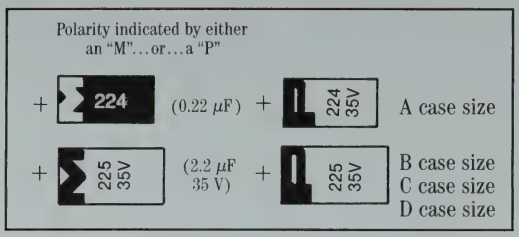
MARKINGS

■ The small physical size of the MOLDED CHIP dictates a minimum amount of alpha-numeric marking on the body of the capacitor. The capacitance in picofarad code and the Rated Working Voltage (DC) will be marked on the B, C, and D case size units. The A case size units may have the capacitance only, marked in picofarad code. All case sizes will have positive polarity indicated at the anode termination. Capacitance may be marked in μF at the manufacturer's option.

POLARITY (Philips Components Unit Identifier) (Positive Termination Indicator)

■ Series 49MC capacitors are polar devices. Proper polarity must be observed or damage to the capacitor and/or the circuit will result. Polarity is marked with either the letter "P" or the letter "M" on the positive end and will also serve as the Philips Components identifier.

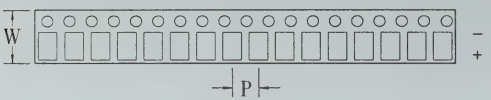
MARKING EXAMPLES BY CASE SIZE



PACKAGING

TAPE & REEL

■ 49MC Series capacitors are shipped in Tape & Reel packaging to facilitate the use of automatic placement equipment. Tape & Reel is per EIA (Electronic Industries Association) specification RS 481. Capacitor orientation within the tape pockets is negative terminal toward sprocket holes and mounting side down. 8 and 12 mm tape widths are used according to case size.

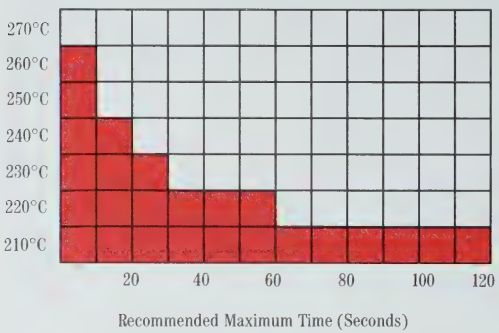


TAPE & REEL SPECIFICATIONS

CASE CODE	(W) Tape Width	(P) Unit Pitch Ctr/Ctr	Quantity per full 7" Reel	Quantity per full 13" Reel
A	8 mm	4 mm	2,000	9,000
B	8 mm	4 mm	2,000	8,000
C	12 mm	8 mm	500	3,000
D	12 mm	8 mm	500	2,500

REFLOW TIMES and TEMPERATURES

■ The optimum reflow profile will include a preheat cycle to provide proper fluxing prior to reflow.



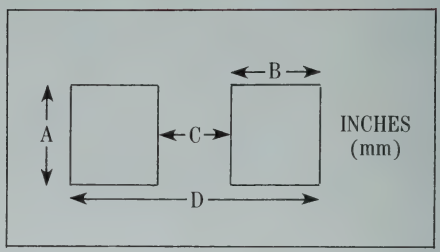
SOLDERABILITY INSPECTION CRITERIA

■ Magnification: 10X

Both termination end faces, excluding the areas of the terminations egressing from the package, shall be covered with a smooth and bright solder coating with no more than a small amount of scattered imperfections, such as pinholes or un-wetted or de-wetted areas. The imperfections shall not be concentrated in one area.

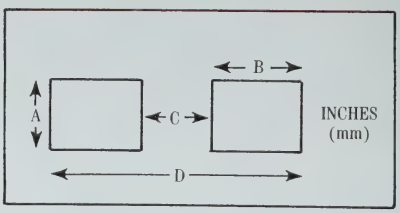
Termination edges are not solderable surfaces.

RECOMMENDED PAD DIMENSIONS FOR REFLOW SOLDERING



CASE SIZE	A MIN.	B MIN.	C NOM.	D NOM.
A	.071 (1.80)	.060 (1.53)	.053 (1.35)	.223 (5.65)
B	.110 (2.80)	.060 (1.53)	.065 (1.65)	.235 (5.95)
C	.110 (2.80)	.082 (2.08)	.124 (3.15)	.337 (8.55)
D	.118 (3.00)	.082 (2.08)	.176 (4.45)	.388 (9.85)

RECOMMENDED PAD DIMENSIONS FOR WAVE SOLDERING



CASE SIZE	A MIN.	B MIN.	C NOM.	D NOM.
A	.034 (0.87)	.065 (1.65)	.053 (1.35)	.223 (5.65)
B	.061 (1.54)	.065 (1.65)	.065 (1.65)	.235 (5.95)
C	.061 (1.54)	.087 (2.20)	.124 (3.15)	.337 (8.55)
D	.066 (1.68)	.087 (2.20)	.176 (4.45)	.389 (9.85)

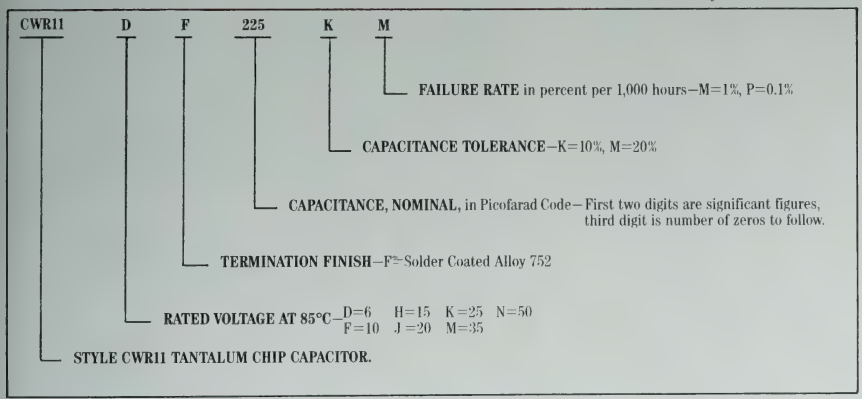
CWR11 ESTABLISHED RELIABILITY

- Series 49MC MOLDED CHIP capacitors are qualified to Exponential Failure Rate Level "P" under specification MIL-C-55365/8, Style CWR11.
- Philips Components provides the CWR11 Molded Chip in only the "F" style termination, Solder-coated alloy 752.
- The military part numbering system and electrical parameter limits for Dissipation Factor and DC Leakage are covered on the following pages. Test information from the military specification follows that, but it is recommended that you obtain the specification and its attendant documents for further clarification of tests and procedures.

STYLE CWR11 ESTABLISHED RELIABILITY MILITARY STYLE TANTALUM CHIP CAPACITORS

MIL-C-55365/8 Military Part Numbering System Example

NOTE: Military Part number does not designate case code


CWR11
D
F
225
K
M
FAILURE RATE in percent per 1,000 hours—M=1%, P=0.1%
CAPACITANCE TOLERANCE—K=10%, M=20%
CAPACITANCE, NOMINAL, in Picofarad Code—First two digits are significant figures, third digit is number of zeros to follow.
TERMINATION FINISH—F=Solder Coated Alloy 752
RATED VOLTAGE AT 85°C—D=6 H=15 K=25 N=50 F=10 J=20 M=35
STYLE CWR11 TANTALUM CHIP CAPACITOR.

CWR11 ELECTRICAL LIMITS & MILITARY CASE CODES

Cap. (nom) µF	Rated VDC 85°C	DC Leakage (max) 25°C µA	85°C µA	125°C µA	Dissipation Factor (max) 25°C %	85°C 125°C	−55°C %	Case Code
2.2	6	0.5	5.0	6.0	6	6	8	A
6.8	6	0.5	5.0	6.0	6	6	8	B
15	6	0.9	9.0	10.8	6	6	8	C
47	6	2.8	28.0	33.6	6	6	8	D
1.5	10	0.5	5.0	6.0	6	6	8	A
4.7	10	0.5	5.0	6.0	6	6	8	B
15	10	1.5	15.0	18.0	6	6	8	C
33	10	3.3	33.0	39.6	6	6	8	D
1.0	15	0.5	5.0	6.0	4	6	6	A
3.3	15	0.5	5.0	6.0	6	6	8	B
10	15	1.6	16.0	19.2	6	6	8	C
22	15	3.3	33.0	39.6	6	6	8	D
.68	20	0.5	5.0	6.0	4	6	6	A
2.2	20	0.5	5.0	6.0	6	6	8	B
4.7	20	1.0	10.0	12.0	6	6	8	C
15	20	3.0	30.0	36.0	6	6	8	D
.47	25	0.5	5.0	6.0	4	6	6	A
1.5	25	0.5	5.0	6.0	6	6	8	B
3.3	25	0.9	9.0	10.8	6	6	8	C
10	25	2.5	25.0	30.0	6	6	8	D
.10	35	0.5	5.0	6.0	4	6	6	A
.15	35	0.5	5.0	6.0	4	6	6	A
.22	35	0.5	5.0	6.0	4	6	6	A
.33	35	0.5	5.0	6.0	4	6	6	A
.47	35	0.5	5.0	6.0	4	6	6	B
.68	35	0.5	5.0	6.0	4	6	6	B
1.0	35	0.5	5.0	6.0	4	6	6	B
1.5	35	0.5	5.0	6.0	6	6	8	C
2.2	35	0.8	8.0	9.6	6	6	8	C
3.3	35	1.2	12.0	14.4	6	6	8	D
4.7	35	1.7	17.0	20.4	6	6	8	D
.10	50	0.5	5.0	6.0	4	6	6	A
.15	50	0.5	5.0	6.0	4	6	6	B
.22	50	0.5	5.0	6.0	4	6	6	B
.33	50	0.5	5.0	6.0	4	6	6	B
.47	50	0.5	5.0	6.0	4	6	6	C
.68	50	0.5	5.0	6.0	4	6	6	C
1.0	50	0.5	5.0	6.0	4	6	6	C
1.5	50	0.8	8.0	9.6	6	6	8	D
2.2	50	1.1	11.0	13.2	6	6	8	D

MIL-C-55365/8—TEST AND CONDITIONS
(Excerpts from the Military Specification)

CAPACITANCE

■ Capacitors shall be tested in accordance with MIL-STD-202, method 305. The following details shall apply:

(a) Test frequency: 120 ±5 Hertz.

(b) Limit of accuracy: Measurement accuracy shall be within ±2 percent of the reading.

(c) Magnitude of polarizing voltage—Maximum DC bias shall be 2.2 volts for all AC measurements. The magnitude of the AC voltage shall be limited to 1.0 volts RMS.

DISSIPATION FACTOR

■ The dissipation factor of each capacitor shall be measured at a frequency of 120 ±5 Hertz (Hz) by means of a polarized capacitance bridge. The bridge shall provide a dial reading accuracy of 0.1% dissipation factor and a measuring accuracy of ± (2 percent of the measured dissipation factor plus 0.1%).

D.C. LEAKAGE

■ D.C. leakage shall be measured using the DC rated voltage at ±2 percent at the applicable test temperature after a maximum electrification period of 5 minutes. A 1,000-ohm resistor shall be placed in series with the capacitor to limit the charging current. A steady source of power, such as a regulated power supply, shall be used. Measurement accuracy shall be within ±2 percent or 0.02 microamps (μa), whichever is greater.

THERMAL SHOCK

■ Capacitors shall be tested in accordance with MIL-STD-202, method 107. The following details and execeptions shall apply:

(1) Mounting of specimens: Chip capacitors shall be mounted on suitable substrate. The substrate material shall be such that it shall not be cause of, nor contribute to, failure of any test for which it may be used. The capacitors shall be mounted on the substrate as follows:

(a) A substrate shall be prepared with metalized surface land areas of proper spacing to permit mounting of chips by soldering the terminations of the chips to the "test card" land areas.

(b) Solder paste, type "R" or "RMA" in accordance with QQ-S-571, shall be applied to terminals or substrates as applicable.

(c) The chip shall then be placed across the metalized land areas of the substrate so as to make contact between chip and substrate land areas.

(d) The substrate shall then be placed in or on a suitable heat transfer unit (molten solder, hot plate, tunnel oven, etc.) with the temperature maintained at 260 ±5°C for 2 minutes (+30, −0 seconds), until the solder paste melts and reflows forming a homogeneous solder bond to the metalized substrate.

(e) All excess flux or solder shall be removed.

(2) Test condition letter: B

(3) Measurements after thermal shock: DC leakage—meet original requirement; Capacitance—shall change no more than 5% from initial measurement; Dissipation Factor—meet original requirement.

(4) Visual requirements: There shall be no evidence of harmful corrosion or mechanical damage or obliteration of marking.

VIBRATION, HIGH FREQUENCY

■ Capacitors shall be tested in accordance with MIL-STD-202, method 204. The following details and exceptions shall apply:

(a) Mounting of specimens—Capacitors shall be mounted on a substrate as specified under thermal shock.

(b) Electrical-load conditions—During the test, the specified DC rated voltage shall be applied to the capacitors.

(c) Test condition letter—D (20 G's).

(d) Duration and direction of motion—4 hours in each of two mutually perpendicular directions (total of 8 hours), one parallel and the other perpendicular to the axis.

(e) Measurements during vibration—During the last cycle, an electrical measurement shall be made to determine intermittent operation or open or short circuiting. Observations shall also be made to determine intermittent contact or arcing or open or short circuiting. Detecting equipment shall be sufficiently sensitive to detect any interruption with a duration of 0.5 ms or greater.

(f) Measurements after vibration—Not applicable.

(g) Examination after test—Capacitors shall be visually examined for evidence of mechanical damage.

RESISTANCE TO SOLDERING HEAT

■ Capacitors shall be tested in accordance with MIL-STD-202, method 210. The following details and exceptions shall apply:

(a) Mounting of specimens—Chip Capacitors shall be mounted on a substrate as specified in Thermal Shock.

(b) Test condition letter—E.

(c) Cooling time prior to measurement after test—Not applicable.

(d) Examination after test—Capacitors shall be visually examined for evidence of mechanical damage.

MOISTURE RESISTANCE

■ Capacitors shall be tested in accordance with MIL-STD-202, method 106. The following details and expections shall apply:

(a) Mounting of specimens—Capacitors shall be mounted as specified in Thermal Shock.

(b) Initial measurements—Capicitance as specified above.

(c) Number of cycles—20 continuous cycles except that steps 7a and 7b shall be omitted.

(d) Loading voltage—Not applicable.

(e) Final measurements—After removal from chamber, capacitors shall be dried for 1 hour at room temperature and, within the next hour, DC leakage, Capacitance and Dissipation Factor shall be measured as specified above.

(f) Examination after test—Capacitors shall be visually examined for evidence of corrosion and mechanical damage.

■ When tested as specified, capacitors shall meet the following requirements:

■ DC leakage—Shall not exceed 200% of the requirement specified.

■ Capacitance—Shall not change more than ±15% from the initial measured value.

■ Dissipation Factor—Shall not exceed 150% of the requirement specified.

■ Visual examination—There shall be no evidence of harmful corrosion or mechanical damage.

STABILITY AT LOW AND HIGH TEMPERATURE

■ Capacitors shall be dried at 125°C for 30 (+4, −0) minutes prior to start of test. The capacitors shall be brought to thermal stability at each test temperature. Thermal stability will have been reached when no further change in capacitance is observed between two successive measurements taken at 15, +2 −0 minute, intervals. Capacitors will meet the following requirements as applicable:

Step 1 (25°C Initial measurements):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within tolerance of the nominal value.
Dissipation factor—Shall not exceed the requirement specified.

Step 2 (−55°C):
Capacitance—Shall be within ±10% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 3 (25°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within 5% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 4 (85°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within 10% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 5 (125°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within ±12% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

Step 6 (25°C):
DC Leakage—Shall not exceed the applicable value specified.
Capacitance—Shall be within 5% of initial 25°C measurement.
Dissipation Factor—Shall not exceed the requirement specified.

SURGE VOLTAGE

■ Capacitors shall be subjected to 1,000 cycles of the applicable surge voltage. The ambient temperature during cycling shall be 85°C. Each cycle shall consist of a 30-second surge voltage application followed by a 30-second discharge period. Voltage application shall be made through a resistor of 33 ohms. The tolerance of the resistor shall be ±5 percent. Each surge voltage cycle shall be performed in such a manner that the capacitor is shorted terminal-to-terminal through a copper bar, or an equivalent low resistance at the end of the 30-second application. An alternative method of shorting the capacitors is discharge through the same resistance that is utilized for charging. After the final cycle, the capacitor shall be stabilized at the inspection conditions, and the DC leakage, Capacitance, and DF shall be measured. When tested as specified, capacitors shall meet the following requirements:

DC Leakage—Shall not exceed the requirement specified.
Capacitance—Shall change not more than ±5% from initial value.
Dissipation Factor—Shall not exceed the requirement specified.

LIFE TEST

A. Capacitors shall be tested in accordance with MIL-STD-202, method 108. The following details and exceptions shall apply:
   (a) Method of mounting—as detailed under thermal shock.
   (b) Test conditions
      (1) Proof Life
         2,000 hours
         125°C
         Derated voltage applied
      (2) Failure Rate Life
         10,000 hours
         85°C
         Rated voltage applied

B. Operating conditions—DC rated voltage 85°C or derated voltage at 125°C, as applicable, shall be applied gradually (not to exceed 5 minutes) either by a slow build up of the voltage or through a resistor which shall be shorted out within 5 minutes. Voltage shall be applied continuously except during measurement period. The impedance of the voltage source, as seen from the terminals of each capacitor, shall not exceed three ohms. Storage batteries or an electronic power supply capable of supplying at least one ampere when a capacitor is shorted shall be used.

C. Measurements during exposure—DC leakage, at the applicable high test temperature and voltage, shall be measured at the following intervals: 0 hours, 240 hours, 1000 hours, 2000 hours, 4000 hours*, 6000 hours*, 8000 hours*, 10,000 hours*.
   *Failure rate (85°C) life only.

D. Measurements after exposure—Capacitors shall be returned to 25°C and visually examined for evidence of harmful corrosion or mechanical damage. DC leakage, Capacitance and Dissipation Factor will then be measured as specified.

■ Following testing there shall be no evidence of harmful corrosion or mechanical damage and the capacitors will meet the following electrical requirements:

2,000 hours:
- at 25°C DCL—initial requirement.
  △ Cap—±5% of initially measured value.
  DF—initial requirement.
- at 85°C DCL—initial requirement.
- at 125°C DCL—initial requirement.

10,000 hours:
- at 25°C DCL—200% of initial requirement.
  △ Cap—within ± 10% of initial measurement.
  DF—initial requirement.
- at 85°C DCL—200% of initial requirement.
- at 125°C DCL—200% of initial requirement.

MARKING

In accordance with MIL-C-55365, capacitors shall be marked as follows:

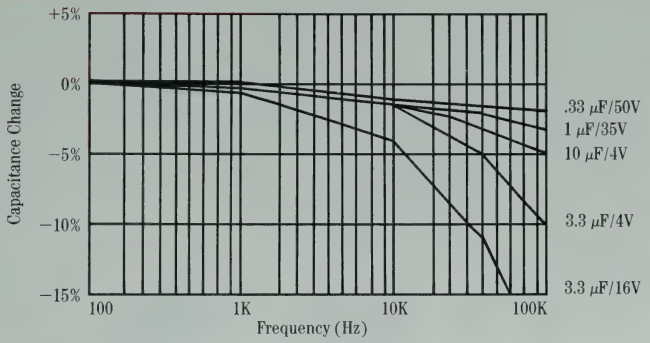
J+	J=JAN += anode terminal
105	capacitance in picofarad code
35P	rated voltage, manufacturer's trademark

SOLDERABILITY

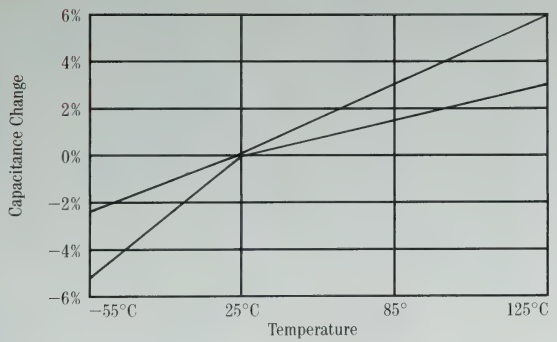
■ Capacitors shall be tested in accordance with MIL-STD-202, method 208. Mounting surfaces shall be dipped to cover the normal mounting surfaces. After the test the immersed mounting surface shall be at least 75% covered with a smooth solder coating and shall exhibit no demetallization or leaching of the terminal ends. The remaining 25% may contain only small pin holes or rough spots, these shall not be concentrated in one area.

TYPICAL CHARACTERISTICS

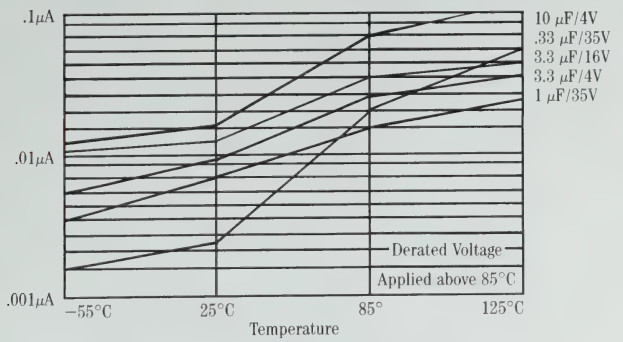
CAPACITANCE CHANGE



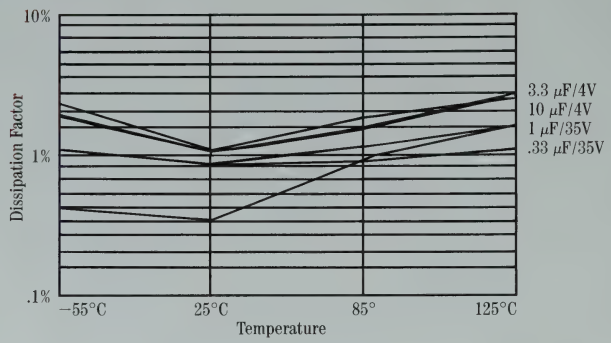
CAPACITANCE CHANGE



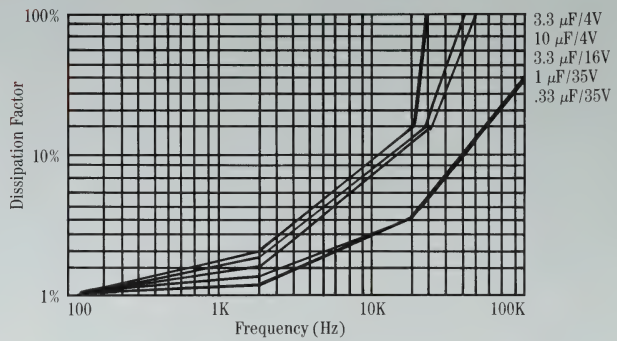
D.C. LEAKAGE



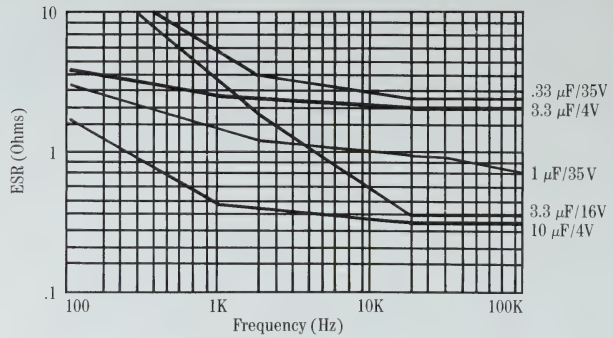
DISSIPATION FACTOR



DISSIPATION FACTOR



E.S.R.



SERIES 3970 SMD® Aluminum Electrolytic Capacitors

DESCRIPTION

- Series 3970 is a wet Aluminum Electrolytic Capacitor ideally suited for surface mounting using all current soldering methods, including vapor phase.
- The electrolytic cell consists of etched and formed aluminum foil electrodes, separated by an electrolyte-impregnated paper strip. The cell is sealed into a very small aluminum can which is then housed in a rectangular plastic case. Two case sizes are available: 9x4.1mmx4.1mm and 12.2x4.1mmx4.1mm.
- The 3970 is mainly used for coupling, decoupling and smoothing in consumer and industrial applications. The capacitors are supplied in reels of 16mm blister tape for AA case size and 24mm for BB case size. (2,000 pieces per reel) or in rails. 12mm for AA case size and 15.8mm for BB case size.

FEATURES

- True SMD Design for surface mounting
- Withstands total immersion in a solder bath at 260°C for 10 sec
- Product available in rails or in blister tape and reel
- Capacitance range: 0.1 to 22μF
- Tolerance: $-10+50\%$ or $\pm 20\%$
- Rated voltage: 6.3 to 63 VDC
- Wide Operating Temperature Range: -40 to $+85$°C
- Load Life: 1000 hrs at 85°C

®SMD is a Service Mark of North American Philips Corporation

STANDARD CAPACITANCE VALUES

Philips Components Part Number	WVDC V	Capacitance µF	Case Code	Maximum E.S.R. OHMS 120Hz, 20°C	Maximum Impedance OHMS 10KHz, 20°C	Max. RMS Ripple MA at 120Hz, 85°C	Maximum Leakage in µA after 1 min.
3970AA100T*6P3B**	6.3	10	AA	48	20	11	4
3970BB220T6P3B	6.3	22	BB	22	9	20	6
3970AA689T010B	10	6.8	AA	59	24	10	4
3970BB150T010B	10	15.0	BB	27	11	18	6
3970AA479T016B	16	4.7	AA	68	26	9	5
3970BB100T016B	16	10	BB	32	12	16	6
3970AA339T025B	25	3.3	AA	87	27	8	5
3970BB689T025B	25	6.8	BB	42	13	14	6
3970AA229T040B	40	2.2	AA	116	32	7	5
3970BB479T040B	40	4.7	BB	54	15	13	7
3970AA108T063B	63	.1	AA	1590	550	2	4
3970AA158T063B	63	.15	AA	1060	367	3	4
3970AA228T063B	63	.22	AA	723	250	3	4
3970AA338T063B	63	.33	AA	482	167	4	4
3970AA478T063B	63	.47	AA	339	117	4	4
3970AA668T063B	63	.68	AA	234	81	5	4
3970AA109T063B	63	1.0	AA	191	55	6	4
3970AA159T063B	63	1.5	AA	149	37	7	5
3970BB229T063B	63	2.2	BB	87	25	11	6
3970BB339T063B	63	3.3	BB	68	17	13	7

*±20% tolerance also available.
Use M in Place of T.

**B=Product shipped in box
T=Product shipped in blister tape on reel
R=Product shipped in rail

MECHANICAL DATA

OUTLINE DRAWING All Dimension in mm

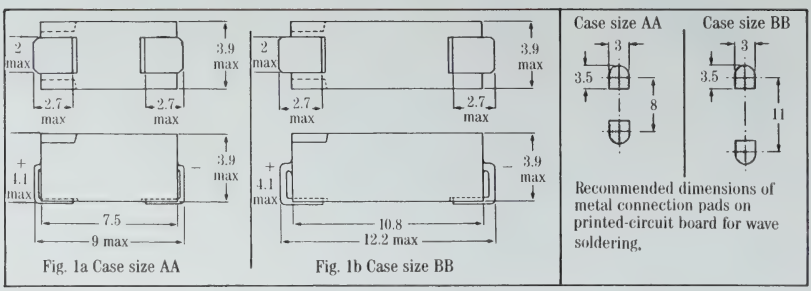


Fig. 1a Case size AA

Fig. 1b Case size BB

Recommended dimensions of metal connection pads on printed-circuit board for wave soldering.

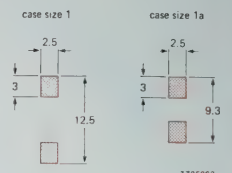


Fig. 9* Recommended dimensions of metal connection pads on printed-circuit board or substrate surface for reflow soldering.

MARKING

■ The capacitors are marked on the top with nominal capacitance, "—" sign to identify the cathode, and code for rated volted (Table 1). The numerals are those of the capacitance in µF, and the position of the letter indicating the rated voltage, marks the position of the decimal point in the capacitance value. Example: 3H3 indicates 3.3 µF, 63V.

Bevelled edges identify the anode end.

Table 1

Rated Voltage V	Code Letter
6.3	C
10	D
16	E
25	F
40	G
63	H

*This information does not include tolerances resulting from printed board design and placement machine inaccuracies.

SOLDERING SPECIFICATIONS

■ The capacitors can be placed and soldered onto printed circuit boards or onto hybrid circuits. Suitable mounting methods include those where the device is totally immersed in a solder bath (260°C, 10 sec), as in wave soldering, and reflow methods where the solder and device are heated together, as in vapor phase soldering.

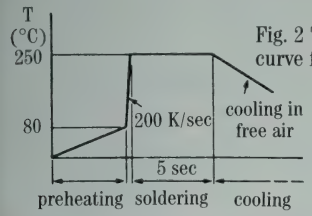


Fig. 2 Typical temperature-time curve for wave soldering.

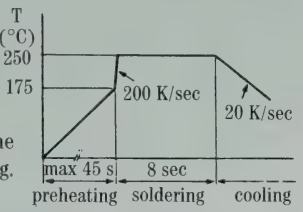


Fig. 3 Typical temperature-time curve for reflow soldering.

■ In both soldering processes, the capacitors reach the actual soldering temperature. The temperature rise caused by preheating and immersion in solder has no adverse effects on the life of the capacitors, provided the restrictions indicated by Fig. 4 are observed. This curve indicates the acceptable combination of temperature and time. The conditions indicated by the solid parts of the curve can be applied once to each capacitor: a preheating stage at or below one of the temperature-time points on part A, and a soldering stage at or below one of the temperature-time points on part B. Furthermore, the time in part B can be split into two, for double soldering. Typically, an example might be a preheating stage at 150°C for 60 sec followed by a first soldering stage for 4 sec at 260°C and directly followed by a second soldering stage for 6 sec at 260°C (total soldering 10 sec at 260°C).

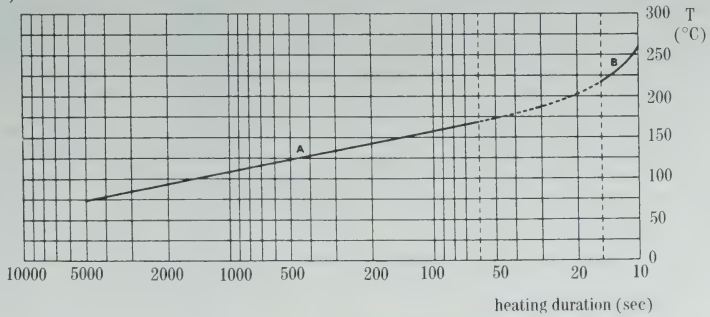
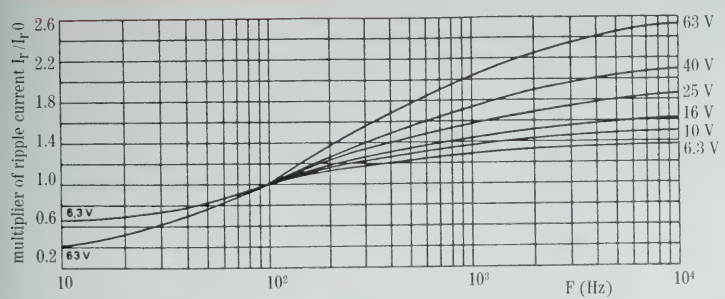


Fig. 4 Preheating (A) and soldering (B) limits for undiminished life expectancy.

TYPICAL PERFORMANCE



RIPPLE CURRENT VS FREQUENCY

Fig. 5 Multiplier of ripple current as a function of frequency: I_r0=ripple current at T_{amb}=85°C, 120 Hz.

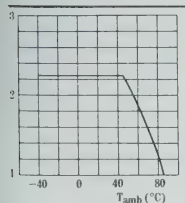
■ Non-sinusoidal ripple current has to be analyzed into a number of sinusoidal currents and the following requirements shall then be satisfied:

$$\sum_n \frac{I_n^2}{r_n} \leq I_r\,max^2$$

I_r max=maximum ripple current at 120 Hz and applicable temperature;

I_n=ripple current at a certain frequency;

$\sqrt{r_n} = I_r/I_r0$=multiplying factor at a same frequency.



RIPPLE CURRENT VS TEMPERATURE

■ Maximum permissible r.m.s. ripple current at 100 Hz and T_{amb}=85°C

Fig. 6 Multiplier of ripple current as a function of ambient temperature; I_r0=ripple current at T_{amb}=85°C, 120 Hz.

IMPEDANCE VS FREQUENCY

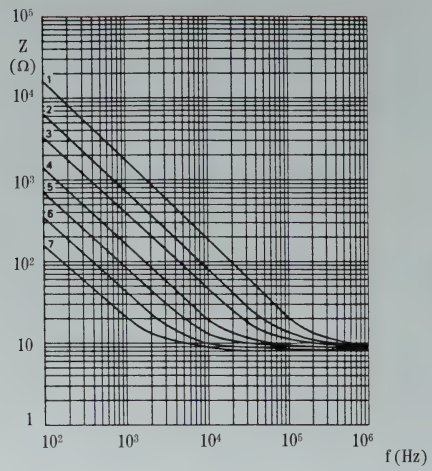


Fig. 7 Typical impedance as a function of frequency at T_{amb}=20°C; case size AA.

Curve 1 = 0.1 μF, 63V; curve 5 = 2.2 μF, 40 V;
curve 2 = 0.22μF, 63V; curve 6 = 4.7 μF, 16 V;
curve 3 = 0.47μF, 63V; curve 7 = 10 μF, 6.3V;
curve 4 = 1 μF, 63V;

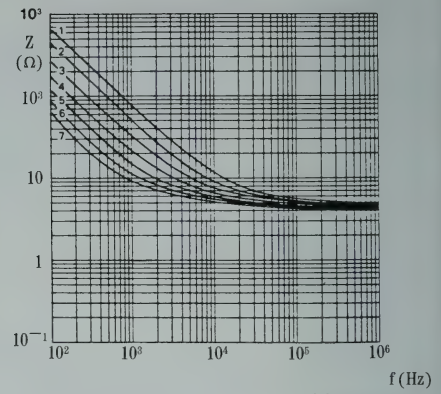


Fig. 8 Typical impedance as a function of frequency at T_{amb}=20°C, case size BB.

Curve 1 = 2.2μF, 63V; curve 5 = 10μF, 16V;
curve 2 = 3.3μF, 63V; curve 6 = 15μF, 10V;
curve 3 = 4.7μF, 40V; curve 7 = 22μF, 6.3V.
curve 4 = 6.8μF, 25V;

Equivalent Series Inductance (ESL)

Case Size AA Typ. 13nH
Case Size BB Typ. 15nH

TESTS AND REQUIREMENTS

■ After *endurance test, 1000 h, 85°C,* the capacitors meet the following requirements:
$\Delta C/C \leq \pm 20\%$,
tan δ ≤ 200% of specified value,
d.c. leakage current ≤ specified value.

After *shelf life test, 500 h, 85°C,* the capacitors meet the same requirements as after endurance test, except for d.c. leakage current: ≤ 200% of specified value. The rated voltage shall be applied to the capacitors for minimum 30 min, at least 24 h and not more than 48 h before measurements.

Resistance to soldering heat: 260±5°C, 10±1 s.

After soldering test, the capacitors meet the following requirements:
$\Delta C/C \leq \pm 10\%$,
tan δ ≤ specified value,
d.c. leakage current ≤ 200% of specified value,
no visible damage.

■ Note: Series 3970 Capacitors are miniature types, general purpose grade.

CAPACITOR CLEANING

After mounting and soldering capacitors on a PC board, they may be cleaned by immersion for up to five minutes in one of the following cleaners:

■ Deionized water at 50 ±5°C.

■ Calgonite (dishwasher detergent) solution of 20 grams/liter at 70 ±5°C.

■ Mixtures of 1,1,2-trichloro-1,2,2-triflouroethane (fluorocarbon 113, Freon TF*) and the following solvents in the weight percent concentrations as indicated:

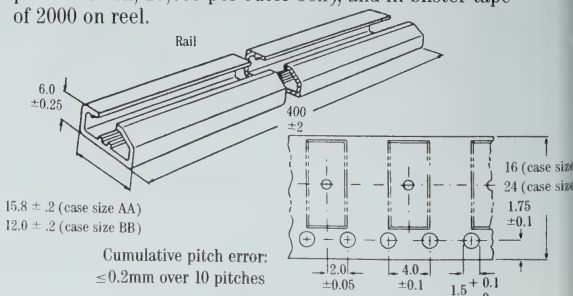
—2 propanol (isopropanol): fluorocarbon 113 from 25:75% to 35:65%
—ethanol: fluorocarbon 113 45:95.5% (equivalent to Freon TE*)
—methanol: nitromethane: fluorocarbon 113 5.7: 0.3: 94.0% (equivalent to Freon TMS*)

The use of any other cleaning procedure will void any warranties specified or otherwise implied for this product.

PACKAGING

All Dimension in mm

■ The capacitors are supplied in rail (100 per rail, 5000 per inner box, 20,000 per outer box), and in blister tape of 2000 on reel.



*Trademark of Dupont de Nemours

SERIES 2800S SMD® TRIMMER CAPACITORS Film Dielectric

DESCRIPTION

■ SMD® Trimmer Capacitors use a plastic film dielectric for excellent long-term stability and low temperature coefficient of capacitance. These units consist of brass rotors and stators separated by film dielectric and enclosed in a plastic case. They are available taped and reeled for automatic assembly and can be reflow, vapor phase or hand soldered.

FEATURES

- Product Available Taped in EIA standard embossed tape
- True SMD Design for Surface Mounting
- Tight TC of −100± 100 PPM/°C for All Styles
- Wide Operating Temperature Range: −40°C to +85°C

PART NUMBER DESIGNATION

Series 2800S SMD® Film Dielectric Trimmer Capacitors can be completely specified using the following designation:

28	07	S	OR505
Planar Trimmer Capacitor	**Largest Dimension in mm**	**SMD® Type**	**Capacitance Range** Min. & Max. with R Denoting Decimal Point, i.e. 0.5 to 5 pF=OR505

ELECTRICAL SPECIFICATIONS

Mepco/Centralab Part Number	Capacitance Range (pF)		L Inches	(mm)	Marking Color
	Min.	Max.			
2807S0R505	0.3±0.2	5–0.5/+3	.087	(2.2)	Orange
2807S0R610	0.4±0.2	10–1/+5	.087	(2.2)	Black
2807S0R815	0.5±0.3	15–0/+7	.094	(2.4)	Blue
2807S1R020	0.7±0.3	20–0/+10	.100	(2.55)	Green

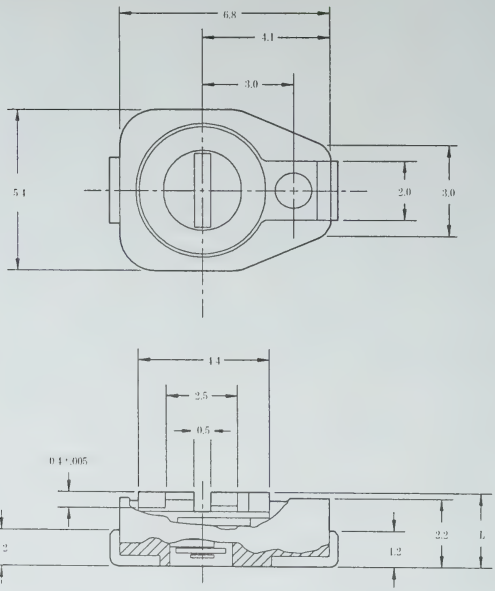
Insulation Resistance Between Stator and Rotor: 10,000 MΩ Minimum
Voltage Rating: 100V DC
Minimum Q @ 10MHz; 1000.
Temperature Coefficient PPM/°C −100±100.

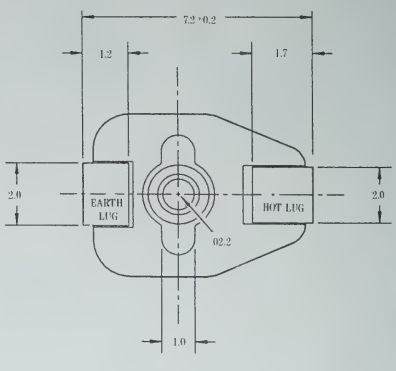
Soldering Maximum: 260°C for 10 seconds
Operating Temperature Range: −40 to 85°C

Part #	L Inches	(mm)
2805OR505	.087	(2.2)
	.087	(2.2)
28075OR610	.094	(2.4)
	.100	(2.55)

MECHANICAL SPECIFICATIONS

■ Dimensions: in Millimeters





SERIES 9C COMMERCIAL SMD® CHIP RESISTORS

DESCRIPTION

■ The surface mounted chip resistor consists of a glass passivated thick film resistive paste screened onto a high purity alumina ceramic substrate. The nominal resistance value is achieved by varying the composition of the paste prior to the screening process and by laser trimming the film after it has been screened on. To insure mechanical and environmental integrity, the chip is covered with a silicon based "procoat." The conductive layer consists of a precious metal and a wrap around termination is deposited at each end to allow mechanical and electrical attachment.

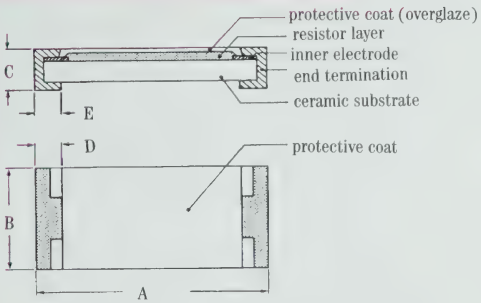
FEATURES

- Superior volumetric efficiency
- Adaptable to high speed automated mechanization assembly
- Allows excellent printed circuit board density as well as utilization of both board sides
- Standard resistance value from 10Ω to 1MΩ for 1% product and 10Ω to 10MΩ for 5% product
- Zero Ω jumper available
- Temperature characteristics of 100 PPM/°C for 1% product and 200 PPM/°C for 5% product
- Operating temperature range of −55°C to 125°C
- Power rating of .125W
- 3 digit marking code available on 5% product

GENERAL SPECIFICATIONS

CHIP SIZE	WATTAGE	TOLERANCE	T.C.	VOLTS	VALUE RANGE
1206	1/4	±5%	200	200	1RO - 10M
1206	1/8	±1%	100	200	100R - 1M
1206	1/8	±1%	50	200	100R - 1M
0805	1/10	±5%	200	150	1RO - 10M
0603	1/16	±5%	200	50	10RO - 1M
0603	1/16	±5%	300	50	1M1 - 6.8M
0603	1/16	±5%	500	50	1R1 - 9R1
ZERO OHM JUMPER AVAILABLE IN ALL SIZES					

MECHANICAL PARAMETER



*SMD is a Service Mark of North American Philips Corporation

		A (Length)	B (Width)	C	D	E
1206	IN.	.126 ±.006/-.004	.063 ±.006	.023 ±.004	.016 ±.010	.020 ±.010
	(MM)	(3.2 ±.15/-.10)	(1.6 ±.15)	(.80 ±.10)	(.45 ±.25)	(.50 ±.25)
0805	IN.	.079 ±.006	.049 ±.006	.024 ±.004	.016 ±.008	.016 ±.006
	(MM)	(2.0 ±.15)	(1.25 ±.15)	(.60 ±.10)	(.40 ±.20)	(.40 ±.20)
0603	IN.	.062 ±.004	.031 ±.006/-.002	.018 ±.004	.012 ±.008	.012 ±.006
	(MM)	(1.6 ±.10)	(.80 ±.15/-.05)	(.45 ±.10)	(.30 ±.20)	(.30 ±.20)

PART NUMBER DESIGNATION

9C 1206 3 A 1002 F K R

- **Rectangular Chip Resistor**
- **Chip Size**
  1260 0603
  0805
- **Power Rating**
  4 = 1/4 2 = 1/10
  3 = 1/8 1 = 1/16
- **Product Class**
  A = Standard
- **Resistance Value**
  3 Digits - ±5%
  4 Digits - ±1%
  Last Digit Represents Multiplier
- **Tolerance**
  F = ±1.0
  J = ±5.0
- **T.C. of R. (PPM/C)**
  H = ±50 L = ±200
  K = ±100 M = ±300
- **Termination**
  R = Wrap Around

PERFORMANCE NOTES

MOUNTING

Chips may be cemented in place for control during the soldering process by screened on solder paste or epoxy and may be mounted on printed circuit boards or ceramic substrates. The solder provides both an electrical contact as well as a mechanical retainer. Tape and reel packaging and rectangular shape with tight dimensional tolerances accommodates automatic placement of the components. Wrap around terminations allow both reflow and wave soldering.

PERFORMANCE NOTES

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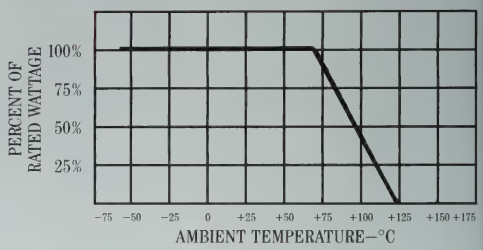
TEST PERFORMANCE

PERFORMANCE CHARACTERISTICS PER EIA-STD-IS-30

TEST	REQUIREMENT 1%, 50 PPM	REQUIREMENT 5%, 200 PPM
Thermal Shock	±(.5%+.05 ohm)	±(.5%+.05 ohm)
Low Temperature Operation	±(.5%+.05 ohm)	±(.5%+.05 ohm)
S.T.O.L.	±(.5%+.05 ohm)	±(.5%+.05 ohm)
High Temperature Exposure	±(.5%+.05 ohm)	±(.5%+.05 ohm)
Effects of Soldering	±(.5%+.05 ohm)	±(.5%+.05 ohm)
Moisture Resistance	±(.5%+.05 ohm)	±(.5%+.05 ohm)
Life	±(.5%+.05 ohm)	±(1%+.05 ohm)
Solderability	95% Minimum Coverage	

ELECTRICAL PARAMETERS

TEMPERATURE DERATING CURVE:



CHIP RESISTOR KITS

SERIES 9C SMD® CHIP RESISTORS (1%)

	QTY. EACH		QTY. EACH		QTY. EACH		QTY. EACH
1. 9C12063A10R0FKR	100	11. 9C12063A3400FKR	100	21. 9C12063A2151FKR	100	31. 9C12063A2002FKR	200
2. 9C12063A47R5FKR	100	12. 9C12063A3920FKR	100	22. 9C12063A2491FKR	100	32. 9C12063A1212FKR	200
3. 9C12063A49R9FKR	100	13. 9C12063A4750FKR	100	23. 9C12063A3321FKR	100	33. 9C12063A1502FKR	200
4. 9C12063A75R0FKR	100	14. 9C12063A4990FKR	100	24. 9C12063A3921FKR	100	34. 9C12063A2152FKR	100
5. 9C12063A1000FKR	200	15. 9C12063A6340FKR	100	25. 9C12063A4641FKR	100	35. 9C12063A3402FKR	100
6. 9C12063A1500FKR	100	16. 9C12063A6490FKR	100	26. 9C12063A4751FKR	200	36. 9C12063A4992FKR	100
7. 9C12063A1690FKR	100	17. 9C12063A9090FKR	100	27. 9C12063A4991FKR	200	37. 9C12063A1003FKR	100
8. 9C12063A2000FKR	100	18. 9C12063A1001FKR	200	28. 9C12063A7501FKR	100	38. 9C12063A2003FKR	200
9. 9C12063A2490FKR	100	19. 9C12063A1211FKR	100	29. 9C12063A8251FKR	100	39. 9C12063A4993FKR	100
10. 9C12063A2670FKR	100	20. 9C12063A2001FKR	200	30. 9C12063A1002FKR	200	40. 9C12063A1004FKR	100

SERIES 9C SMD® CHIP RESISTORS (5%)

	QTY. EACH		QTY. EACH		QTY. EACH		QTY. EACH
1. 9C12063A10R0JLR	100	11. 9C12063A7500JLR	100	21. 9C12063A1002JLR	200	31. 9C12063A2203JLR	100
2. 9C12063A27R0JLR	100	12. 9C12063A9100JLR	100	22. 9C12063A1502JLR	100	32. 9C12063A4703JLR	100
3. 9C12063A47R0JLR	100	13. 9C12063A1001JLR	200	23. 9C12063A2702JLR	100	33. 9C12063A6803JLR	100
4. 9C12063A51R0JLR	100	14. 9C12063A1501JLR	100	24. 9C12063A3302JLR	100	34. 9C12063A1004JLR	200
5. 9C12063A1000JLR	200	15. 9C12063A2201JLR	200	25. 9C12063A3902JLR	100	35. 9C12063A1504JLR	100
6. 9C12063A2200JLR	100	16. 9C12063A2701JLR	100	26. 9C12063A4702JLR	200	36. 9C12063A2204JLR	100
7. 9C12063A3300JLR	100	17. 9C12063A3301JLR	100	27. 9C12063A5102JLR	100	37. 9C12063A3304JLR	100
8. 9C12063A3900JLR	100	18. 9C12063A4701JLR	200	28. 9C12063A8202JLR	200	38. 9C12063A5104JLR	100
9. 9C12063A4700JLR	100	19. 9C12063A5101JLR	200	29. 9C12063A1003JLR	100	39. 9C12063A1005JLR	100
10. 9C12063A6800JLR	100	20. 9C12063A7501JLR	100	30. 9C12063A1503JLR	100	40. 9C12063A0R00JLR	200

SERIES 9B Precision MELF SMD® Resistors

DESCRIPTION

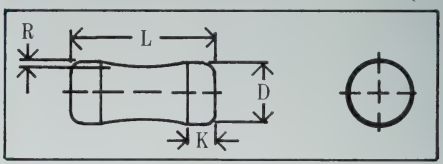
■ The MELF precision resistor benefits from the technology employed by Beyschlag of West Germany in the manufacture of the leaded Space Miser metal film resistors. The MELF resistor consists of a high alumina core on which metal film is deposited. A cap is applied at each end and the resistor is spiralled to value. The resistor is then coated, color coded, and end caps treated to facilitate soldering.

FEATURES

- Tolerance Down to 0.1%
- Temperature Coefficients Down to ±15 PPM/°C
- ¼ & ⅛ Watt Power Ratings in Miniature Size
- Tape and Reel Packaging for Automatic Handling
- Specially Treated End Caps for Excellent Solderability
- Color Coded for Easy Identification
- Thin Film Resistance Element for Low Current Noise
- Zero ohm, jumper, available

MECHANICAL DATA

OUTLINE DRAWING All Dimensions in inches (mm)

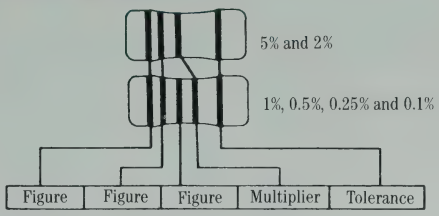


Body Style	L Min	L Max	D Max	K	R Max	Scale Defin.
Mini Melf 9B1406	.136-.142 (3.47-3.60)		0.055 (1.4)	.023-.034 (0.6-0.85)	0.006 (0.15)	in mm
Micro Melf 9B0805	0.087 (2.2)		0.039 (1.1)	0.014-0.018 (0.35-0.45)	0.002 (0.05)	in mm

PERFORMANCE SPECIFICATIONS

TEST	PROCEDURE	REQUIREMENTS
Thermal Shock	−65 to + 155°C, 30 minutes at each temperature, 5 cycles	ΔR max. ±(0.25% + 0.05Ω)
Short Time Overload	2.5X RCWV, not to exceed 400V. 5 seconds	ΔR max. ±(0.25% + 0.05Ω)
Moisture	Per Mil. Std. 202 Method 106 to conditions of Mil-R-55342	ΔR max. ±(0.25% + 0.05Ω)
Damp Heat	56 days at 40°C, 93% R.H. with 0.1 RCWV, not to exceed 16 V, applied	ΔR max. (+1.0%/−0.5% + 0.05Ω)
Solderability	5 seconds at 230°C	95% coverage minimum
Effect of Soldering	3 seconds at 350°C	ΔR max. ±(0.25% + 0.05Ω)
Life Test	1000 hours, rated power at 70°C. Voltage not to exceed 200V. Power applied 90 minutes on, 30 minutes off	R≤330K, ΔR max. ±(0.25% + 0.05Ω) R>330K, ΔR max. ±(0.5% + 0.05Ω)

PART MARKING



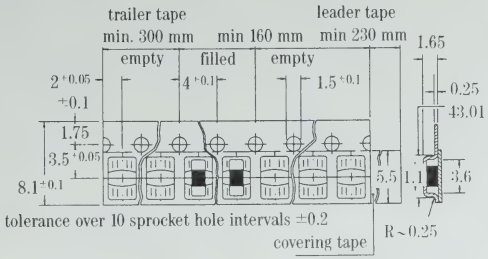
Temperature coefficient is indicated by body color

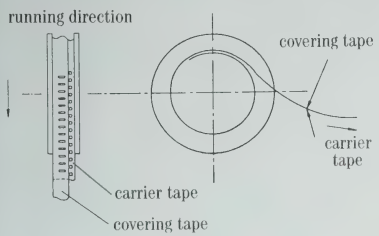
Blue: ±50 PPM/°C Pink: ±25 PPM/°C
Violet: ±15 PPM/°C

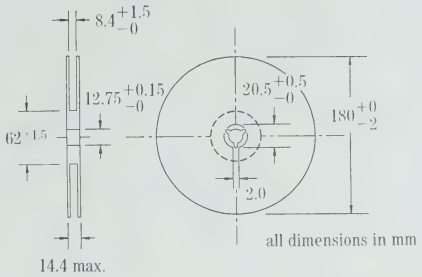
Color	Figure	Multiplier	Tolerance
Black	0	1	—
Brown	1	10	1%
Red	2	100	2%
Orange	3	1K	—
Yellow	4	10K	—
Green	5	100K	.5%
Blue	6	1M	.25%
Violet	7	—	.1%
Gray	8	—	—
White	9	—	—
Gold	—	.1	5%
Silver	—	.01	—

AUTO-PLACEMENT MACHINES AND COMPONENT ADHESIVES

■ A variety of auto-placement machines are available which are capable of placing bulk and/or taped and reeled parts. Associated with these machines are component adhesive application equipment, which may or may not be integrated into the auto-placement machines. Generally, manufacturers of integrated systems define the type of adhesive required. User specification will define the type of equipment best suited to a particular application.







PACKAGING

■ Series 9B Precision MELF resistors are available in bulk, packed in plastic containers, 1000 pieces per container and taped and reeled, per EIA RS-481, in 8 mm blister tape. Quantity per reel is 3000 pieces.

ELECTRICAL SPECIFICATIONS

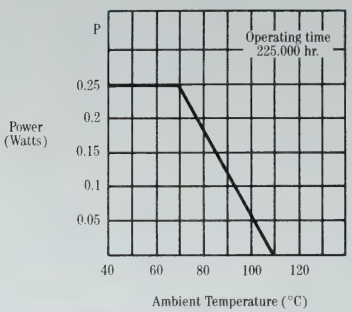
T.C., TOLERANCE, OHMIC VALUE RANGE

TC 10^{-6}/K		5% (J)	2% (G)	1% (F)	0.5% (D)	0.25% (C)	0.1% (B)
±50	Mini Melf 1406	0.22Ω-10MΩ	1Ω-10MΩ	1Ω-10MΩ	10Ω-475KΩ	22Ω-330KΩ	43Ω-330KΩ
	Micro Melf 0805	1Ω-2.2MΩ	10Ω-1MΩ	22Ω-220KΩ	Consult Factory	Consult Factory	Consult Factory
±25	Mini Melf 1406 Micro Melf 0805	Not Applicable Not Applicable	Not Applicable Not Applicable	10Ω-475KΩ 22Ω-150KΩ	10Ω-475KΩ Consult Factory	22Ω-330KΩ Consult Factory	43Ω-330KΩ Consult Factory
±15	Mini Melf 1406 Micro Melf 0805	Not Applicable Not Applicable	Not Applicable Not Applicable	Not Applicable Not Applicable	10Ω-221KΩ Consult Factory	22Ω-221KΩ Consult Factory	43Ω-221KΩ Consult Factory

Zero Ohm Jumper available in Mini Melf and Micro Melf.

APPLICATION INFORMATION

POWER DERATING



FREQUENCY RESPONSE

■ A special "HF" version of the 9B Mini-MELF has been developed having improved RF characteristics. The inductive reactances have been minimized on values ranging from 4.7 Ohms to 470 Ohms (5% tolerance). Figures 4 and 5 compare the standard Mini-MELF and HF Mini-MELF resistors. (Notice that the impedance has been normalized to the dc resistance.)

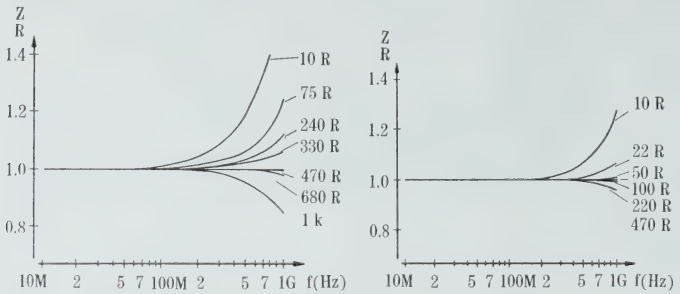


Figure 4: Frequency response of standard Mini-MELFs.

CURRENT NOISE

■ When a dc current passes through a resistor, voltage fluctuation occurs. This results in noise which can be measured by an rms voltmeter. Current noise is generally presented as a μVrms/Vdc ratio (rms voltage produced by a given dc voltage). Since the band-pass of the measuring circuit is one decade centered on 1KHz, this ratio is known as "microvolts per volt in a decade" noise index. The power of the noise index can be calculated by using the following equation:

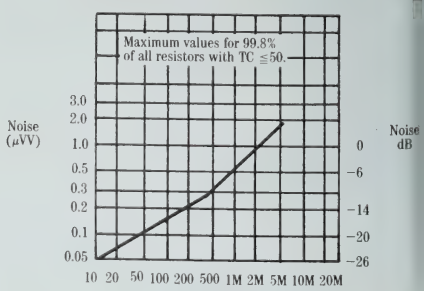
$$\text{Noise Index (dB)} = 20 \log_{10} (\mu\text{Vrms/Vdc})$$

The current noise for 9B Mini-MELF resistors is presented in Figure 3.

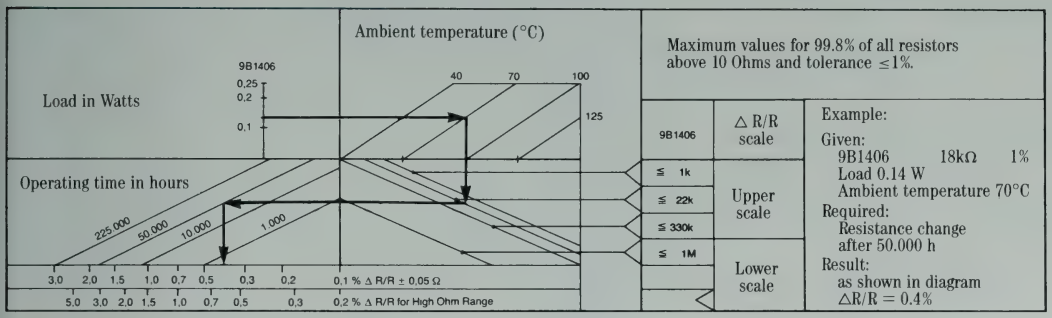
■ Current noise is dependent on the type of resistive material, film thickness, the shape and size of the resistive path, and the quality of spiralling (used to establish desired resistance value).

■ Current noise is an important cause of interference at low level audio frequencies or in low frequency circuits.

CURRENT NOISE



TIME-STABILITY NOMOGRAM



BEND TEST

■ Printed circuit boards are frequently subjected to flexural forces during chassis mounting, thermal mismatch, and/or vibration. Numerous occurrences of terminal fracture/separation in ceramic chip components have been reported by the electronics industry, which has prompted surface mounted component bend testing.

■ Series 9B Mini-MELF resistors are soldered to a 1.5 mm thick printed circuit board which is placed upon two supports, each 45 mm from the center of the body (see Figure 7). A force sufficient to deflect the board 1 mm is applied to a 20 mm wide block, which is centered on the back of the board. While in this state of flexure, the dc resistance of the Mini-MELF is measured. Any resistance change must not exceed +/− (0.25% +0.05 Ohms). Series 9B Mini-MELF resistors can be subjected to 5 flexures of 5 mm deflection without resistor interruption.

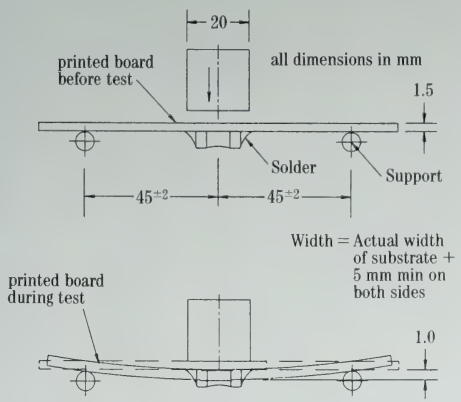


Figure 7: Bend test fixture used to test the effects of pc board flexure.

PULSE LOAD—SINGLE PULSE

■ The 9B Mini-MELF resistors are capable of withstanding single voltage pulses in excess of the maximum continuous working voltage without resistance degradation. This is dependent on the pulse duration and the peak pulse voltage.

■ Figure 6 shows the results of discharging a 16uF capacitor through a 1 kOhm Mini-MELF. The capacitor was initially charged to noncritical voltage levels and, as the test progressed, incremented to the point of resistor destruction. New resistors were used at each increment. As shown, significant resistance change began to occur at 390 Vdc. Notice that the resistance value approached infinity asymptotically at approximately 508 Vdc, the point where the resistive layer underwent destruction.

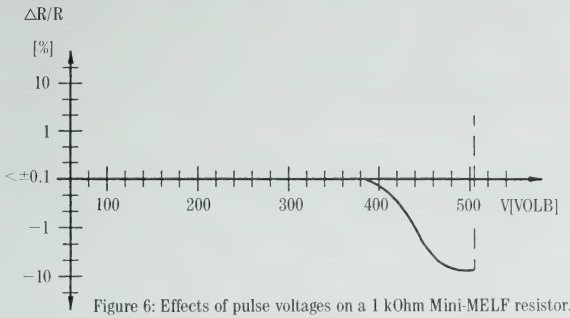


Figure 6: Effects of pulse voltages on a 1 kOhm Mini-MELF resistor.

PULSE LOAD CHARACTERISTICS

Examples for pulse groups

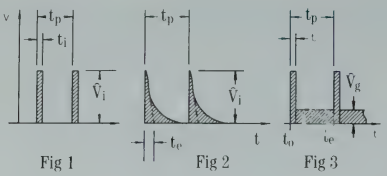
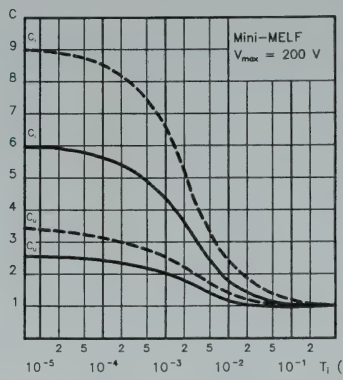


Fig 1 Fig 2 Fig 3



--- Operating time 10 000 hours
— Operating time 225 000 hours

Example:	Pulse load rating for continuous operation
Given:	Mini-MELF, R = 1 kΩ; ϑ_a=70°C; $\hat{V}_i$=50 V; t_i=2 ms; t_p=0.1 S (rectangular pulse see fig. 1)
Limits:	P_{70}=0.25 W; Vmax=200 V
From diagram:	c_i=3.5; c_u=1.8
Condition: (1)	For special case rectangular puls $\frac{\hat{V}_i^2}{R} \cdot \frac{t_i}{t_p} = 0.005\ W \leq 0.25\ W = P_{70}$
Condition (2):	$I\hat{V}_iI = 50\ V \leq c_i \cdot \sqrt{P_{70} \cdot R} = 55\ V$
Condition (3):	$I\hat{V}_iI = 50\ V \leq c_u \cdot Vmax = 360\ V$
Result:	All three conditions are fulfilled, the load is permissible.

■ Philips Components Mini-MELF metal film resistors with high dissipation ceramic CORES have a specially good pulse loadability. For a short time the resistors can be loaded up to 81 times their rated dissipation without impairing their good long term characteristics. The permissible pulse load must fulfill 3 conditions simultaneously:

1. The average value of the pulse load must not be greater than the permissible dissipation of the resistor at the given ambient temperature ϑ

$$P\vartheta \leq \frac{1}{t_p \cdot R} \int_{ta}^{te} \hat{V}_i^2\, dt$$

The solution of the integral shows for the following special cases:

Rectangular pulse $P\vartheta \leq \frac{\hat{V}_i^2 \cdot t_i}{R \cdot t_p} + \frac{Vg}{R}\left(1 - \frac{ti}{tp}\right)$ Fig. 3

Exponential pulse $P\vartheta \leq \frac{\hat{V}_i^2 \cdot \tau_e}{R \cdot 2 \cdot t_p}$ Fig. 2

2. The pulse voltage at the resistor must be smaller than the product rated voltage · c_i

$\hat{V}_i \leq c_i \cdot \sqrt{P\vartheta \cdot R}$

3. The pulse voltage at the resistor must be smaller than the product Vmax · c_u

$V_i \leq c_u \cdot Vmax$

The course of $\hat{V}_i$ must be measured directly on the resistor!

P	= Permissible dissipation in Watts at the ambient temperature ϑ
t_p	= Period time
R	= Resistance value
V_i	= Peak voltage of the pulse
t_i	= Pulse time
V_g	= d.c. voltage between the pulses
t_a	= Time at the beginning of the pulse period
t_e	= Time at the end of the pulse period
Vmax	= Limiting element voltage for continuous operation of the resistor
c_i	= Factor interdependent on time for exceeding the rated dissipation
c_u	= Factor interdependent on time for the permissible exceeding of Vmax
τ_e	= Time constant of the exponential pulse

The conditions ② and ③ must also be fulfilled for "needle pulses" with pulse times <1μsec. Lack of attention to the needle pulses can cause a defect in the resistor. The data for pulse loadability are only conditionally applicable for pulse rise times less than 10^{-8}.

PART NUMBER DESIGNATION

Philips Components' MELF Resistors can be completely specified using the following designation:

9B	1406 0805	4	A	1002	C	F	B
MELF RESISTOR	MELF SIZE .142 X 0.55 inch 3.6 X 1.4 mm .087 X .039 inch 2.2 X 1.1 mm	POWER RATING (70°C) .25 Watt=4 .125 Watt=3	PRODUCT CLASS A=Standard Z=Custom	RESISTANCE VALUE 100=Significant Digits 2=Multiplier (for values less than 100Ω use "R" as decimal designator.) i.e.: 68R0=68Ω 1002=10KΩ	RESISTANCE TOLERANCE B=±.10% F=±1.0% C=±.25% G=±2.0% D=±.5% J=±5.0%	TEMPERATURE COEFFICIENT PPM/°C F=±15 C=±50 E=±25	PACKAGING B=Bulk T=Tape and Reel

MEPCOPAL

SERIES ST-4 SURFACE MOUNT TRIMMERS

DESCRIPTION

■ MEPCOPAL'S ST-4 series gives you the best of both worlds: a high performance trimmer in the smallest SMD package available. This low profile, single turn device has been designed to provide reliability as well as performance: its O-ring seal and high temperature capabilities enable the ST-4 to withstand soldering and cleaning processes used on larger sealed SMD's. A precious metal alloy brush wiper provides excellent setting stability in conjunction with low contact resistance variation. J-lead, gull wing, and even a through hole pin style are offered to make a place for the ST-4 on *your* circuit board.

FEATURES

- Miniature outline 4.5 x 5.0 mm/.177 x .197 inches
- Low profile 2.3 mm/.091 inches
- Sealed with an O ring for immersion cleaning processes
- Withstands high temperature soldering processes
- Available with J-lead and gull wing pin styles for surface mounting, plus a leaded version for thru-hole mounting
- Packaged for automatic insertion, both reel and magazine. Tape and reel meets EIA-481-A and utilizes mylar tape
- Manufactured with robotics for outstanding quality and uniformity

PART NUMBER DESIGNATION

ST-4 ____ RESISTANCE CODE
PIN STYLE ____ A=(J-Hook) B=(Gull Wing) C=(Through Hole)
PACKAGING: ____ M=(Magazine) T=(Tape & Reel) (Blank)=Bulk
MODEL

®SMD is a Service Mark of North American Philips Corporation

GENERAL SPECIFICATIONS

ELECTRICAL	
Resistance range	10Ω~2MΩ
Resistance tolerance	±20%
Power ratings	0.25W (70°C), 0W (125°C)
Max. input voltage	200V
Max. wiper current	100mA
Electrical angle, nominal	210°
End resistance, max.	1% of resistance value or 2Ω, whichever is greater
Contact resistance variation	1% of resistance value or 3Ω, whichever is greater
Operating temperature	−55°C~125°C
Temp. coefficient, max.	10Ω to 50Ω: ±250ppm/°C, 100Ω~2MΩ: ±100ppm/°C
Insulation resistance, min.	1,000MΩ (DC500V)
Dielectric strength	500Vrms (1 minute)
MECHANICAL	
Mechanical angle, nominal	240°
Operating torque, max.	100gcm
Stop strength, min.	300gcm

ENVIRONMENTAL (MIL-R-22097/MIL-STD-202)

Item	Test conditions	△R/R	S.S.
Thermal shock	−65°C~125°C, 5 cycles	±2%	±1%
Humidity	80~98%RH, 10 cycles, 240 hrs.	±2%	–
Shock	100G, 6 directions, 3 times	±1%	±1%
Vibration	20G, 10~2,000Hz, 12 hrs.	±1%	±1%
Soldering heat	260°C 10 sec./or 215° 3 min.	±1%	–
Load life	70°C, rated power, 1,000 hrs.	±3%	±1%
Low temp. operation	−55°C, 2 hrs.	±2%	±2%
High temp. exposure	125°C, 250 hrs.	±3%	±2%
Rotational life	100 cycles	±(2Ω +3%)	–

△R/R: Change in total resistance, S.S.: setting stability

PACKAGING

ST-4A & B 1. Reeled tape (500 pcs per reel) tape width:12mm part pitch : 8mm
2. Plastic magazine (50 pcs per stick)
3. Vinyl bag (in bulk) (100 pcs per bag)

ST-4C 1. Plastic magazine (50 pcs per stick)
2. Vinyl bag (in bulk) (100 pcs per bag)

STANDARD RESISTANCE VALUES

CODE	OHMS	CODE	OHMS	CODE	OHMS	CODE	OHMS	CODE	OHMS	CODE	OHMS
100	10	101	100	102	1K	103	10K	104	100K	105	1M
200	20	201	200	202	2K	203	20K	204	200K	205	2M
500	50	501	500	502	5K	503	50K	504	500K		

APPLICATION NOTES

Parts will meet original specifications after exposure to:

Reflow Soldering: . . . . . Peak Temperature=240°C
Solder Melting Point Temp.=180°C
Time @ Melting Point=10 seconds maximum

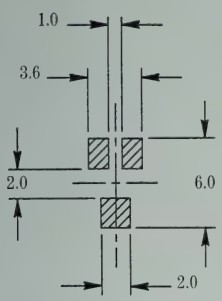
Vapor Phase Soldering: . . . 180 seconds maximum @ 215°C or
10 seconds maximum @ 260°C

Wave Soldering: . . . . . Peak Temperature=260°C
Time in Solder Wave=4 seconds maximum

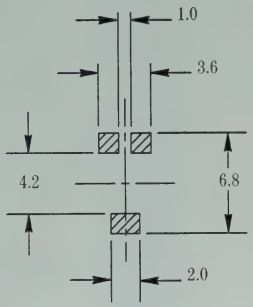
Manual Soldering: . . . . . Soldering Iron Tip Temp.=350°C maximum
Soldering Time=3 seconds maximum
Soldering Iron Wattage=40 watts maximum

P.C. BOARD PAD OUTLINE

ST-4A



ST-4B

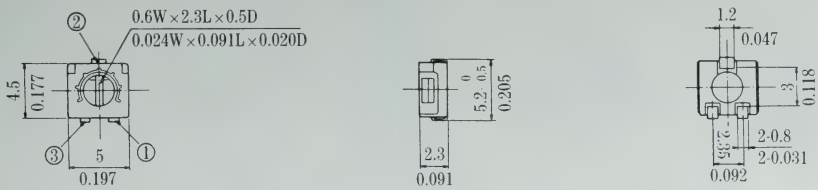


METRIC/ENGLISH CONVERSION TABLE	
mm	inches
0.3	.012
1.0	.039
2.0	.079
3.6	.142
4.2	.165
6.0	.236
6.8	.268

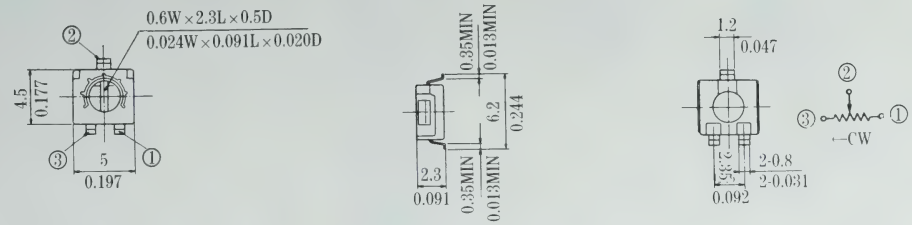
NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.

DIMENSIONS (IN MM/INCH)

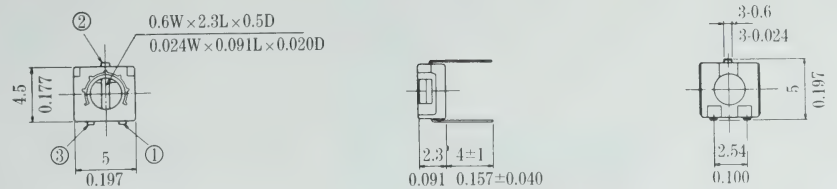
ST-4A
Top adjustment
J-Lead



ST-4B
Top adjustment
Gull Wing



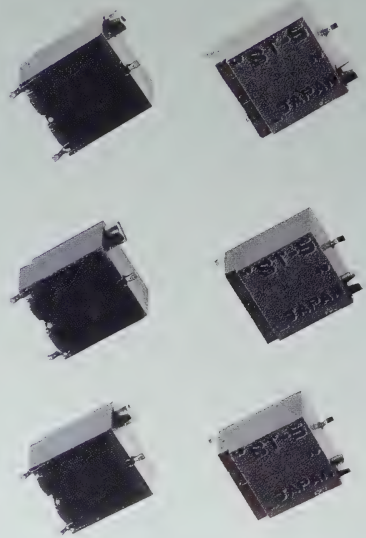
ST-4C
Top adjustment
Through Hole



Tolerances are ±0.3 mm and ±.012 inches

MEPCOPAL

SERIES ST-5
SURFACE MOUNT TRIMMER



DESCRIPTION

■ Long vapor phase cycles are no problem with the ST-5. It easily withstands three minutes at 215°C. Packaged in bulk or tape and reel, this high quality trimmer is specifically designed for your automated assembly line. The ST-5 supplies you with four pin styles and an ultra low profile. Of course, like all Mepcopal trimmers, the ST-5 is completely sealed, so boardwashing is no problem.

FEATURES

- Miniature outline: .236″ x .266″ x .169″ high (6.0mm x 6.75mm x 4.3mm high)
- Sealed for immersion cleaning processes
- Withstands high temperature soldering processes
- Precious metal alloy multi-contact wiper
- 4 pin styles to choose from

PACKAGING

1. Reeled Tape (500 pcs per reel)
   Tape Width: 16mm
   Part Pitch: 12mm
2. Vinyl Bag (in bulk)
3. Magazine (50 pcs per stick)

STANDARD RESISTANCE VALUES

CODE	OHMS	CODE	OHMS	CODE	OHMS
100	10	101	100	102	1K
103	10K	104	100K	105	1 Meg
200	20	201	200	202	2K
203	20K	204	200K	205	2 Meg
500	50	501	500	502	5K
503	50K	504	500K		

PART NUMBER DESIGNATION

ST-5 ____ ____ ____ ____

- ____ MODEL
- ____ PACKAGING: M=Magazine, T=Tape & Reel, (Blank)=Bulk
- ____ PIN STYLE: P, R, W, X
- ____ RESISTANCE CODE

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GENERAL SPECIFICATIONS

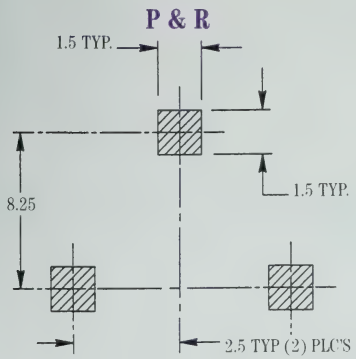
ELECTRICAL	
Resistance Range	10Ω to 2MΩ
Resistance Tolerance	±10%
Power Rating	0.25W @ 85°C derated to 0W @ 125°C
Maximum Input Voltage	200V
Maximum Wiper Current	100 mA
Resolution	Essentially Infinite
End Resistance, Maximum	1% or 2Ω, whichever is greater
Contact Resistance Variation	1% or 3Ω, whichever is greater
Operating Temperature Range	−55°C to +125°C
Temp. Coeff. of Resistance	250 ppm/°C (10Ω to 50Ω), 100 ppm/°C (100Ω to 2MΩ)
Dielectric Strength	600 V AC for 1 minute
Insulation Resistance	1000 MΩ @ 500 V DC
Electrical Angle (Nominal)	11 turns
MECHANICAL	
Mechanical Angle (Nominal)	14 turns
Shaft Torque, Maximum	200 g-cm (2.8 oz-in)
Stops	Wiper Idles

ENVIRONMENTAL

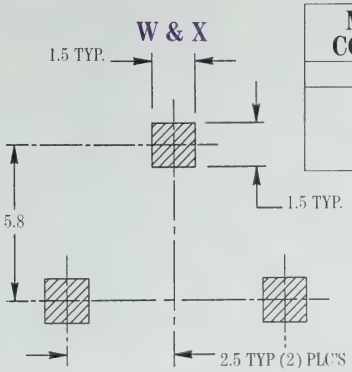
Item	Test conditions	ΔR/R	S.S.
Soldering Heat	215°C for 3 minutes, or 260°C for 10 seconds	±1%	—
Thermal Shock	−65°C to 125°C, 5 cycles	±1%	±1%
Humidity	−10°C to 65°C (80-98% RH) 240 hrs.	±1%	—
Vibration	20G, 10 to 2000 Hz, 12 hrs.	±1%	±1%
Shock	100G, 6 directions, 3 times	±1%	±1%
Load Life	1000 hrs. @ 85°C	±2%	±1%
Low Temp. Operation	2 hrs. @ −55°C	±2%	±2%
High Temp. Exposure	250 hrs. @ 125°C	±2%	±2%
Rotational Life	200 cycles: 10Ω to 200Ω 500Ω to 2MΩ	±3% + 0.5Ω ±2% + 0.5Ω	
Immersion Seal	No leaks @ 85°C		

P.C. BOARD PAD OUTLINE

P & R



W & X



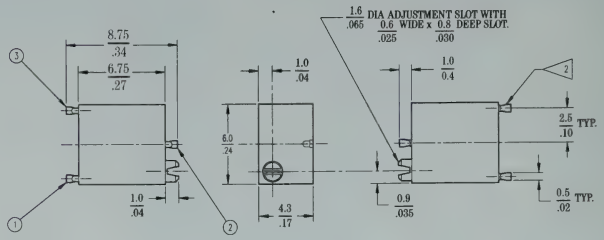
METRIC/ENGLISH CONVERSION TABLE

mm	inches
1.5	.059
2.5	.098
5.8	.228
8.25	.325

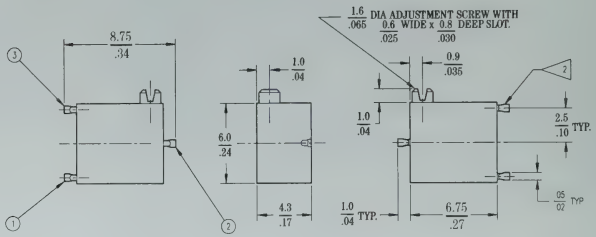
NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.

DIMENSIONS (IN MM/INCH)

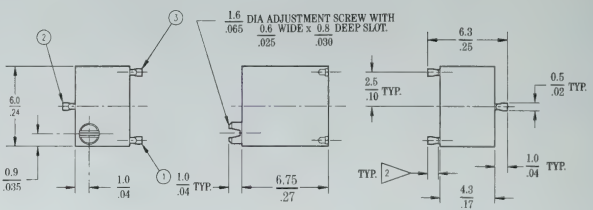
ST-5P



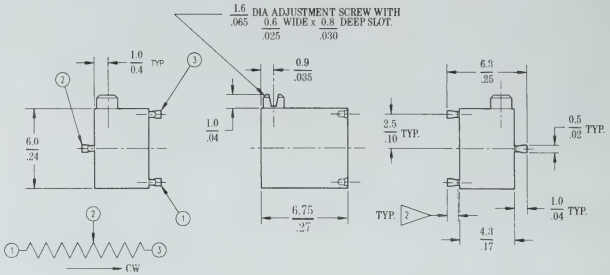
ST-5R



ST-5W



ST-5X

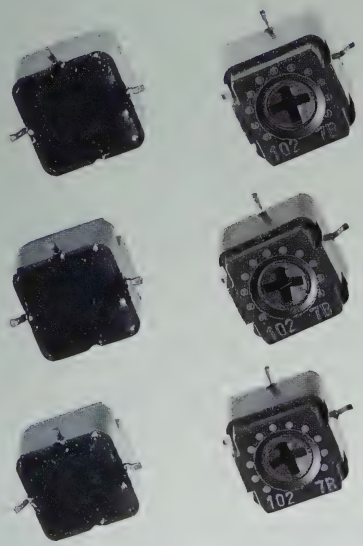


NOTES:

1. All dimensions are in millimeters (top) and inches (bottom). Tolerances are ±0.3mm and ±.012 inches.
2. Flattened portion of leads shall be at least 0.6mm / .025" long.

MEPCOPAL

SERIES ST-6
SURFACE MOUNT TRIMMERS



DESCRIPTION

■ Here it is! The ideal high power, close tolerance, surface mount trimmer available for your application *today.* The ST-6 is also sealed against immersion and all boardwashing processes. Long soldering times are no problem for this trimmer: it handles 3 minutes at 215°C with ease. In addition, it has been specifically designed for automatic adjustment.

FEATURES

- Sealed with an O-ring for immersion cleaning processes
- High temperature capability
- Precious metal alloy multi-contact wiper
- 0.5 watt power rating at 70°C
- Designed for automatic adjustment

PACKAGING

- Vinyl Bag (bulk)

STANDARD RESISTANCE VALUES

CODE	OHMS	CODE	OHMS	CODE	OHMS
100	10	101	100	102	1K
103	10K	104	100K	105	1 Meg
200	20	201	200	202	2K
203	20K	204	200K	205	2 Meg
500	50	501	500	502	5K
503	50K	504	500K		

PART NUMBER DESIGNATION

®SMD is a Service Mark of North American Philips Corporation

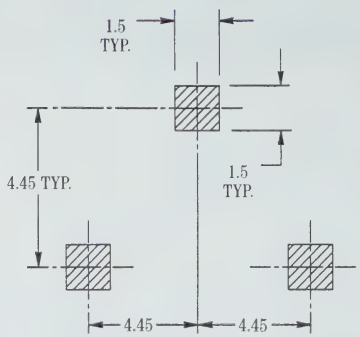
GENERAL SPECIFICATIONS

ELECTRICAL	
Resistance Range	10Ω to 2MΩ
Resistance Tolerance	10%
Operating Temp. Range	−55°C to 125°C
Temp. Coeff. of Resistance	10Ω, 20Ω: 250 ppm/°C, 50Ω to 2MΩ: 100 ppm/°C
Power Rating	0.5 Watt @ 70°C derated to 0 Watt @ 125°C
Maximum Input Voltage	200 V
Maximum Wiper Current	100 mA
End Resistance	2Ω or 1%, whichever is greater
Dielectric Strength	900 V AC for 1 minute
Insulation Resistance	1000MΩ, 500 V DC
Contact Resistance Variation	3Ω or 1%, whichever is greater
Electrical Angle	220°
MECHANICAL	
Mechanical Angle	260°
Adjustment Torque	200 gm-cm (2.8 oz-in) maximum
Stop Strength	0.5 kg-cm (7 oz-in)
Terminal Strength	1 kg

ENVIRONMENTAL

Item	Test conditions	ΔR/R	S.S.
Thermal Shock	−65°C to 125°C	±1%	±1%
Humidity	−10°C to 65°C (80-98% RH) 240 hrs.	±2%	—
Vibration	20G, 10 to 2000 Hz, 12 hrs.	±1%	±1%
Shock	100G, 6 directions, 3 times	±1%	±1%
Soldering Heat	10 s @ 260°C or 3 min. @ 215°C	±1%	±1%
Load Life	1000 hrs. @ 70°C	±3%	±1%
Low Temp. Operation	2 hrs. @ −55°C	±2%	±2%
High Temp. Exposure	250 hrs. @ 125°C	±3%	±2%
Rotational Life	200 cycles	±3% + 2Ω	
Immersion Seal	No leaks @ 85°C		

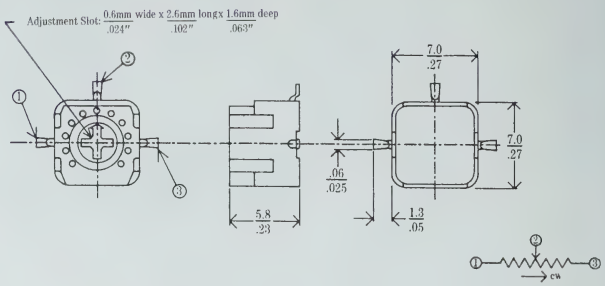
P.C. BOARD PAD OUTLINE



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS

DIMENSIONS (IN MM/INCH)

ST-6P



NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS (TOP) AND INCHES (BOTTOM). TOLERANCES ARE ±0.3MM AND ±.012 INCHES.

METRIC/ENGLISH CONVERSION CHART

mm	inches
1.5	.059
4.45	.175

MEPCOPAL

SERIES CS-4 MINIATURE SURFACE MOUNT SELECTOR SWITCH

DESCRIPTION

■ Mepcopal introduces their CS-4 miniature rotary selector switch, the smallest outline surface mount switch currently available. The CS-4 is a double throw switch available in single or double pole versions. A self cleaning precious metal alloy contact enhances performance and provides high reliability. A high temperature housing material allows the CS-4 to withstand soldering processes with time/temperature profiles of up to 260°C±5°C for 5 minutes. Cleaning operations present no problem: The CS-4 is permanently sealed with an O-ring to prevent any contamination of the contact mechanism.

FEATURES

- 3 pin styles available
- Fully automated manufacturing
- O-ring seal
- High temperature housing material
- Available on tape and reel

PART NUMBER DESIGNATION

CS-4

- PIN STYLE: A=J-Hook, B=Gull Wing, C=Through Hole
- PACKAGING: T=Tape & Reel*, (blank)=Bulk
- CONTACT TYPE: Y=Non-Shorting with "neutral" detent, N=Non-Shorting without "neutral" detent
- NUMBER OF CONTACTS: 2=2 contacts 3=3 contacts
- NUMBER OF POLES: 1=1 pole, 2=2 poles
- MODEL NUMBER

*Tape & Reel not available for "C" pin style.

GENERAL SPECIFICATIONS

ELECTRICAL:

Contact Rating:..... DC resistive load=0.5VA
maximum current=100mA
maximum voltage=16V

ELECTRICAL:

Contact Resistance: . . . . 100 milliohms maximum @ 1kHz and 20 mV maximum.
Insulation Resistance: . . . 100 Megohms minimum @ 500VDC
Dielectric Strength: . . . . 1mA maximum leakage current after 1 minute @ 500VAC, 50Hz.

MECHANICAL:

Shaft Torque: . . . . . 100 gm-cm maximum
Stop Strength: . . . . . 250 gm-cm minimum
Solderability: . . . . . 75% minimum coverage after 3 seconds @ 230°C

ENVIRONMENTAL:

TEST	CONDITIONS	PERFORMANCE CRITERIA
Vibration:	10-55-10Hz @ 1.5mm amplitude 3 directions, 2 hours each	Contact bounce=0.1 millisecond max. No mechanical damage.
Shock:	50G, 11 milliseconds, 6 directions, 3 times each	Contact bounce=0.1 millisecond max. No mechanical damage.
Durability:	200 cycles with no load or 200 cycles with 16VDC, 30mA load	Contact Res.=100 mOhms max. Insulation Resistance=10 Megohms min.
Low Temp. Exposure:	16 hours @ −40°C	No performance reduction. No mechanical damage.
High Temp. Exposure:	16 hours @ 70°C	No performance reduction. No mechanical damage.
Humidity:	48 hours @ 90% to 95% relative humidity @ 40°C.	Contact resistance=100 milliohms max. Insulation resistance=10 Megohms min. No mechanical damage.
Thermal Shock:	30 minutes @ −40°C then 30 minutes @ 70°C 5 cycles	Contact Resistance=100 milliohms maximum. No mechanical damage.
Soldering Heat:	total immersion for 10 seconds in 260°C solder.	No performance reduction. No mechanical damage.

Operating Temp. Range: −25~+70°C
Storage Temp. Range: −40~+70°C

APPLICATION NOTES

Parts will meet original specifications after exposure to:

Infra-Red Soldering: . . . . Peak Temperature=240°C
Solder Melting Point Temp.=180°C
Time & Melting Point=10 seconds maximum

Vapor Phase Soldering: . . . 180 seconds maximum @ 215°C

Wave Soldering: . . . . . Peak Temperature=260°C
Time in Solder Wave=4 seconds maximum

Manual Soldering: . . . . . Soldering Iron Tip Temp.=300°C Max.
Soldering Time=3 seconds maximum

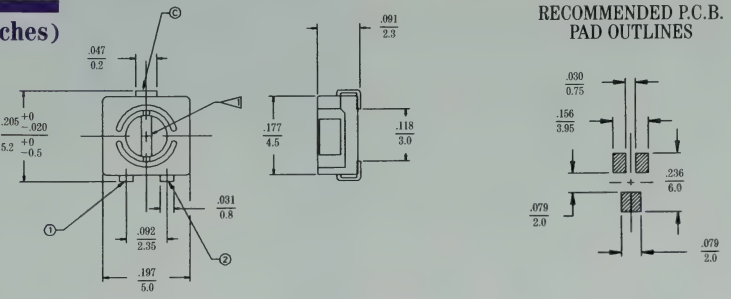
Cleaning: . . . . . Freon TE, 1-1-1 Trichloroethane or Ethanol may be used for cleaning. Cleaning should take place after components cool to 70°C, in order to avoid excessively rapid cooling.

PACKAGING

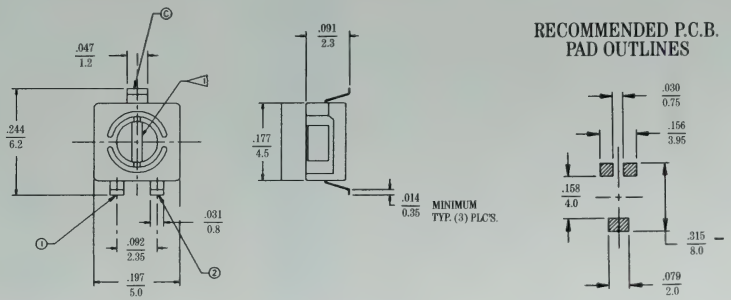
TAPE & REEL	BULK
Pcs/Pkg=500	Pcs/Pkg=100
Tape Width=12mm	
Part Pitch=8mm	

DIMENSIONS (IN mm/Inches)

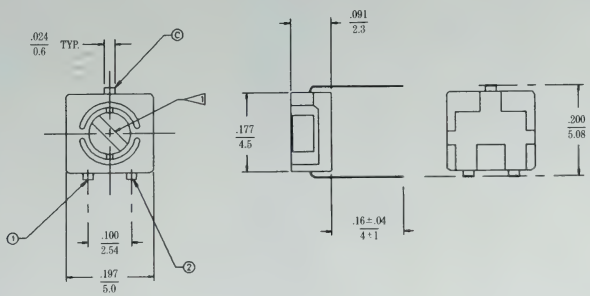
CS-4-12YA (J-Hook)



CS-4-12YB (Gull Wing)



CS-4-12YC (Through Hole)

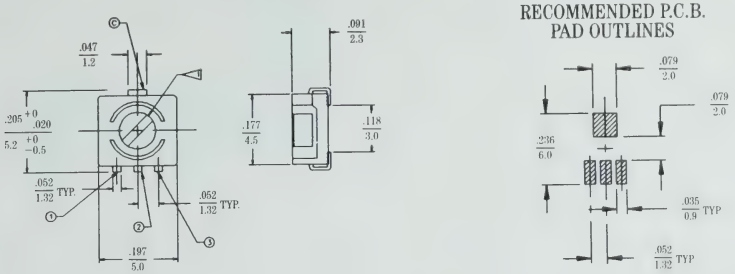


NOTES:

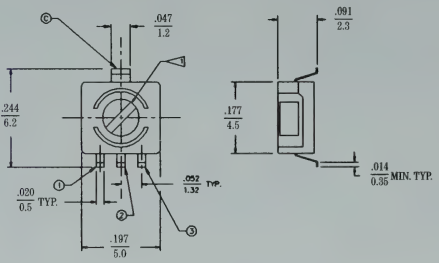
1. Adjustment slot: .091 / 2.3 long x .024 / 0.6 wide x .020 / 0.5 deep.
2. All dimensions are in inches. / millimeters
3. Unless otherwise specified, all tolerances are +/− .012 / 0.3

SCHEMATIC

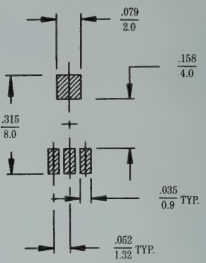
CS-4-13NA (J-Hook)



CS-4-13NB (Gull Wing)



RECOMMENDED P.C.B. PAD OUTLINES

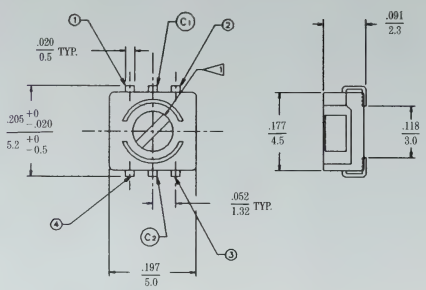


NOTES:

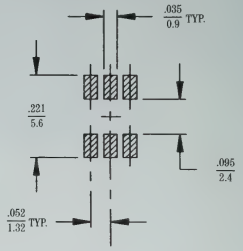
1. Adjustment slot: .091 / 2.3 long x .024 / 0.6 wide x .020 / 0.5 deep.
2. All dimensions are in inches. / millimeters
3. Unless otherwise specified, all tolerances are +/− .012 / 0.3

SCHEMATIC

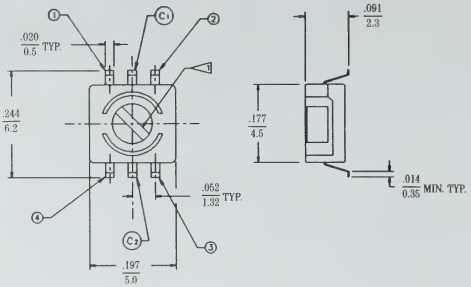
CS-4-22YA (J-Hook)



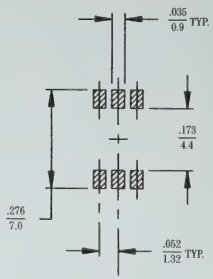
RECOMMENDED P.C.B. PAD OUTLINES



CS-4-22YB (Gull Wing)



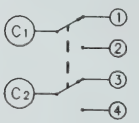
RECOMMENDED P.C.B. PAD OUTLINES



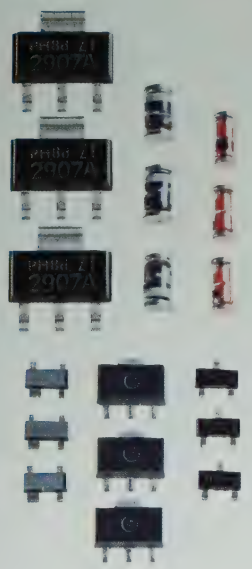
NOTES:

1. Adjustment slot: .091 / 2.3 long x .024 / 0.6 wide x .020 / 0.5 deep.
2. All dimensions are in inches. / millimeters
3. Unless otherwise specified, all tolerances are +/− .012 / 0.3

SCHEMATIC



SURFACE MOUNT TRANSISTORS AND DIODES



■ A pioneer in Surface Mount products, Philips invented the SOT-23 industry standard SM package. Offering full expertise and innovation in Surface Mount technology, Philips has introduced the newest medium-power one-watt SM package, the SOT-223 and has the broadest product range in SOT-89, SOT-143, and MELF diode packages.

■ Our Surface Mount devices, as with all our discrete semiconductors, are tested and manufactured to consistently high quality control standards. Both bulk and tape-and-reel packaging are available; our tape-and-reel packaging conforms to EIA-RS481A and IEC286-3 specifications.

■ The SOT-223 is the first surface mount package for discrete semiconductors that can safely dissipate up to one watt on standard PCBs at an ambient temperature of 60°C. Expertly designed to handle high frequency applications, the SOT-223 package is especially useful in mobile communications equipment, VLSI test equipment, and anywhere else where greater power dissipation or low thermal impedance is a concern.

DIODES
General Purpose/ Switching
Bandswitch
Variable Capacitance
Schottky
Rectifier
Voltage Reference
Zeners

TEMPERATURE SENSORS

TRANSISTORS
General Purpose/ Switching
Darlington
High Frequency
Broadband
Low Noise
High Voltage
FET's

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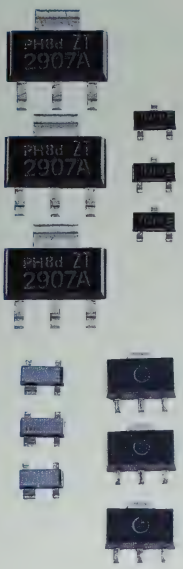
GENERAL PURPOSE SMD NPN TRANSISTORS

DESCRIPTION

■ Philips Components general purpose transistors combine the highest quality standards with state-of-the-art production equipment to fulfill the need for generic, low-cost devices. These transistors provide a broad selection of current ratings, gains and saturation voltages to address a variety of circuit applications. They are offered in a choice of surface mount packages, providing the designer with alternatives for different power requirements, circuit board substrate materials, and assembly processing techniques.

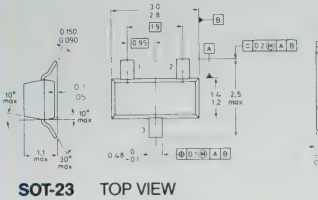


FEATURES

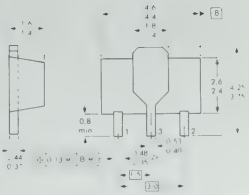
- Continuous current ratings up to 1A
- Complementary NPN and PNP devices
- SOT-89 for medium power applications
- SOT-223 for 1W power at 60°C on printed circuit boards

MECHANICAL DATA

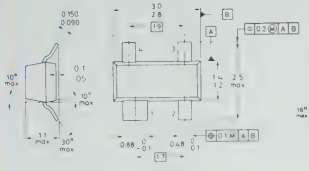
(Dimensions in mm)



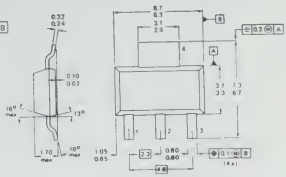
SOT-23 TOP VIEW



SOT-89 BOTTOM VIEW



SOT-143 TOP VIEW

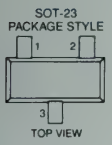


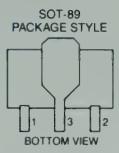
SOT-223

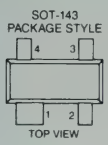
ELECTRICAL SPECIFICATIONS

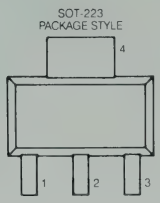
TYPE	PACKAGE	RATINGS			h_{FE}		$V_{CE(sat)}$		f_T	PINOUT
		V_{CEO} V	V_{CBO} V	I_C mA	min./max. at I_C/V_{CE} mA/V		MAX. AT I_C/I_B V	mA/mA	typ MH_z	
NPN										
BC868	SOT-89	20	25	1000	85/375	500/1	0.50	1000/100	60	F
BCP68	SOT-223	20	25	1000	85/375	500/1	0.50	1000/100	60	R
BC818-16	SOT-23	25	25	500	100/250	100/1	0.62	500/50	100	F
BC818-25	SOT-23	25	25	500	160/400	100/1	0.62	500/50	100	F
BC818-40	SOT-23	25	25	500	250/600	100/1	0.62	500/50	100	F
BCX20	SOT-23	25	30	500	100/600	100/1	0.62	500/50	200	F
BC848A	SOT-23	30	30	200	110/220	2/5	0.25	10/0.5	300	F
BC848B	SOT-23	30	30	200	200/450	2/5	0.25	10/0.5	300	F
BC848C	SOT-23	30	30	200	420/800	2/5	0.25	10/0.5	300	F
BCV61	SOT-143	30	30	100	100/800	2/5	0.25	10/0.5	300	G
PMBT2222	SOT-23	30	60	600	100/300	150/10	0.4	150/15	>250	F
BCW31	SOT-23	32	32	100	110/220	2/5	0.25	10/0.5	300	F
BCW32	SOT-23	32	32	100	220/450	2/5	0.25	10/0.5	300	F
BCW33	SOT-23	32	32	100	420/800	2/5	0.25	10/0.5	300	F
BCW60A	SOT-23	32	32	200	120/220	2/5	0.35	10/0.25	250	F
BCW60B	SOT-23	32	32	200	180/2/5	2/5	0.35	10/0.25	250	F
BCW60C	SOT-23	32	32	200	250/460	2/5	0.35	10/0.25	250	F
BCW60D	SOT-23	32	32	200	380/630	2/5	0.35	10/.25	250	F
PMBTA20	SOT-23	40	40	100	40/400	5/10	0.25	10/1	>125	F
PMBT3903	SOT-23	40	60	200	50/150	10/1	0.20	10/1	>250	F
PMBT3904	SOT-23	40	60	200	100/300	10/1	0.20	10/1	>300	F
PXT3904	SOT-89	40	60	200	100/300	10/1	0.20	10/1	>300	F
PXT4401	SOT-89	40	60	600	100/300	150/1	0.4	150/15	>250	F
PMBT2222A	SOT-23	40	75	600	100/300	150/10	0.3	150/15	>300	F
PXT2222A	SOT-89	40	75	600	100/300	150/10	0.3	150/15	>300	F
PZT2222A	SOT-223	40	75	600	100/300	150/10	0.3	150/15	>300	R
BC817-16	SOT-23	45	45	500	100/250	100/1	0.62	500/50	100	F
BC817-25	SOT-23	45	45	500	160/400	100/1	0.62	500/50	100	F
BC817-40	SOT-23	45	45	500	250/600	100/1	0.62	500/50	100	F
BCP54	SOT-223	45	45	1000	40/250	150/2	0.5	500/50	130	R
BCX54	SOT-89	45	45	1000	40/250	150/2	0.50	500/50	130	F
BCX70G	SOT-23	45	45	200	120/220	2/5	0.35	10/0.25	250	F
BCX70H	SOT-23	45	45	200	180/310	2/5	0.35	10/0.25	250	F
BCX70J	SOT-23	45	45	200	250/460	2/5	0.35	10/0.25	250	F
BCX70K	SOT-23	45	45	200	380/630	2/5	0.35	10/0.25	250	F
BC847A	SOT-23	45	50	200	110/220	2/5	0.25	10/0.5	300	F
BC847B	SOT-23	45	50	200	200/450	2/5	0.25	10/0.5	300	F
BC847C	SOT-23	45	50	200	420/800	2/5	0.25	10/0.5	300	F
BCW71	SOT-23	45	50	100	110/220	2/5	0.25	10/0.5	300	F
BCW72	SOT-23	45	50	100	200/450	2/5	0.25	10/0.5	300	F
BCW81	SOT-23	45	50	100	420/800	2/5	0.25	10/0.5	300	F
BCX19	SOT-23	45	50	500	100/600	100/1	0.62	500/50	200	F
BCP55	SOT-223	60	60	1000	40/250	150/2	0.5	500/50	130	R
BCX55	SOT-89	60	60	1000	40/250	150/2	0.50	500/50	130	F
PMBTA05	SOT-23	60	60	500	50/-	100/1	0.25	100/10	>100	F
BCV71	SOT-23	60	80	100	110/220	2/5	0.25	10/0.5	300	F
BCV72	SOT-23	60	80	100	200/450	2/5	0.25	10/0.5	300	F
BC846A	SOT-23	65	80	200	110/220	2/5	0.25	10/0.5	300	F
BC846B	SOT-23	65	80	200	200/450	2/5	0.25	10/0.5	300	F
BCP56	SOT-223	80	100	1000	40/250	150/2	0.5	500/50	130	R
BCX56	SOT-89	80	100	1000	120/220	2/5	0.50	500/50	130	F
PMBTA06	SOT-23	80	80	100	50/-	100/1	0.25	100/10	>100	F

PINOUT DIAGRAMS









	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT F: SOT-23	E	B	C	—
PINOUT F: SOT-89	E	B	C	—
PINOUT G: SOT-143	B,C_2	C_1	E_1	E_2
PINOUT R: SOT-223	B	C	E	C

MARKING CODES

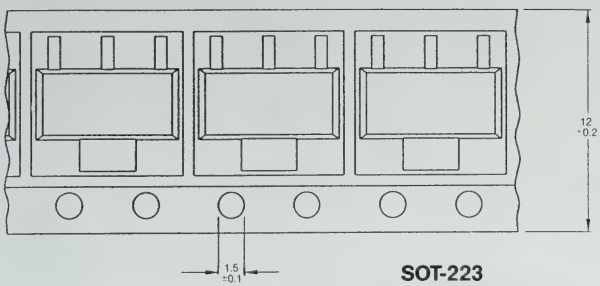
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BC817-16	6A	BC848C	1L	BCW60B	AB	BCX70J	AJ
BC817-25	6B	BC868	CAC	BCW60C	AC	BCX70K	AK
BC817-40	6C	BCP54	*	BCW60D	AD	PMBT2222	1B
BC818-16	6E	BCP55	*	BCW71	K1	PMBT2222A	1P
BC818-25	6F	BCP56	*	BCW72	K2	PMBT3903	1Y
BC818-40	6G	BCP68	*	BCW81	K3	PMBT3904	1A
BC846A	1A	BCV61	D91	BCX19	U1	PMBTA05	1H
BC846B	1B	BCV71	K7	BCX20	U2	PMBTA06	1G
BC847A	1E	BCV72	K8	BCX54	BA	PMBTA20	1C
BC847B	1F	BCW31	D1	BCX55	BE	PXT2222A	P1P
BC847C	1G	BCW32	D2	BCX56	BH	PXT3904	P1A
BC848A	1J	BCW33	D3	BCX70G	AG	PXT4401	P2X
BC848B	1K	BCW60A	AA	BCX70H	AH	PZT2222A	*

*See individual device data sheet

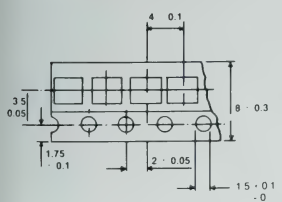
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

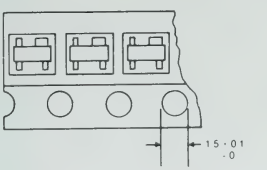
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



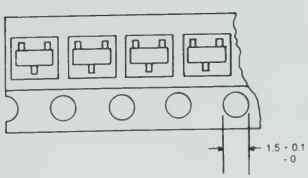
SOT-223
TAPE DIMENSIONS
AND ORIENTATION



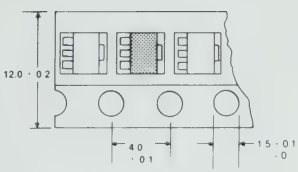
SOT-23 and SOT-143
TAPE DIMENSIONS



SOT-143
ORIENTATION



SOT-23
ORIENTATION



SOT-89
TAPE DIMENSIONS
AND ORIENTATION

GENERAL PURPOSE SMD PNP TRANSISTORS

DESCRIPTION

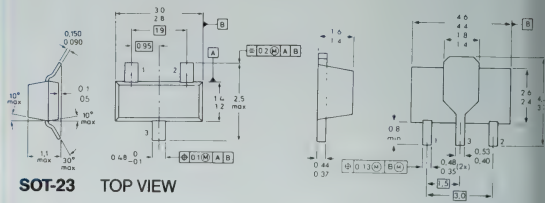
■ Philips Components general purpose transistors combine the highest quality standards with state-of-the-art production equipment to fulfill the need for generic, low-cost devices. These transistors provide a broad selection of current ratings, gains and saturation voltages to address a variety of circuit applications. They are offered in a choice of surface mount packages, providing the designer with alternatives for different power requirements, circuit board substrate materials, and assembly processing techniques.

FEATURES

- Continuous current ratings up to 1A
- Complementary NPN and PNP devices
- SOT-89 for medium power applications
- SOT-223 for 1W power at 60°C on printed circuit boards

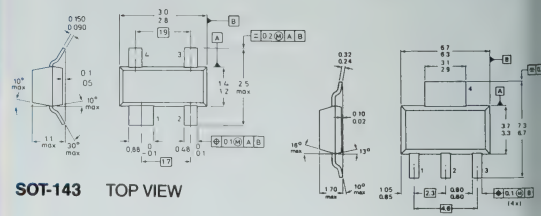
MECHANICAL DATA

(Dimensions in mm)



SOT-23 TOP VIEW

SOT-89 BOTTOM VIEW



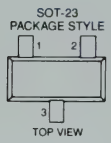
SOT-143 TOP VIEW

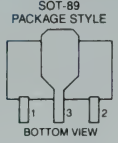
SOT-223

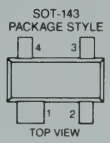
ELECTRICAL SPECIFICATIONS

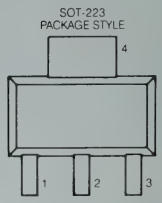
TYPE	PACKAGE	RATINGS			h_{FE}		$V_{CE(sat)}$		f_T	PINOUT
		V_{CEO} V	V_{CBO} V	I_C mA	min./max. at I_C/V_{CE} mA/V		max. at I_C/I_B V	mA/mA	typ MH_z	
PNP										
BC869	SOT-89	20	25	1000	85/375	500/1	0.50	100/100	60	F
BCP69	SOT-223	20	25	1000	85/375	500/1	0.50	1000/100	60	R
BCX18	SOT-23	25	–	500	100/600	100/1	0.62	500/50	100	F
BC808-16	SOT-23	25	30	500	100/250	100/1	0.70	500/50	100	F
BC808-25	SOT-23	25	30	500	160/400	100/1	0.7	500/500	100	F
BC808-40	SOT-23	25	30	500	250/600	100/1	0.7	500/500	100	F
BC858A	SOT-23	30	30	100	125/250	2/5	0.30	10/0.5	150	F
BC858B	SOT-23	30	30	100	220/475	2/5	0.3	10/0.5	150	F
BC858C	SOT-23	30	30	100	420/800	2/5	0.3	10/0.5	150	F
BCV62	SOT-143	30	30	100	100/800	2/5	0.30	10/0.5	150	G
BCW29	SOT-23	32	32	100	120/260	2/5	0.30	10/0.5	150	F
BCW30	SOT-23	32	32	100	215/500	2/5	0.30	10/0.5	150	F
BCW61A	SOT-23	32	32	200	120/200	2/5	0.25	10/0.5	180	F
BCW61B	SOT-23	32	32	200	180/310	2/5	0.25	10/0.5	180	F
BCW61C	SOT-23	32	32	200	250/460	2/5	0.25	10/0.5	180	F
BCW61D	SOT-23	32	32	200	380/630	2/5	0.25	10/0.5	180	F
PMBTA70	SOT-23	40	40	100	40/100	5/10	0.25	10/1	>125	F
PMBT3906	SOT-23	40	40	200	100/300	10/1	0.25	10/1	>250	F
PMBT4403	SOT-23	40	40	600	100/300	150/2	0.40	150/5	>200	F
PXT3906	SOT-89	40	40	200	100/300	10/1	0.25	10/1	>250	F
PXT4403	SOT-89	40	40	600	100/300	150/2	0.4	150/15	>200	F
PMBT2907	SOT-23	40	60	600	100/300	150/10	0.4	150/15	>200	F
BCP51	SOT-223	45	45	1000	40/250	150/2	0.50	500/50	50	R
BCX17	SOT-23	45	–	500	100/600	100/1	0.62	500/50	100	F
BCX51	SOT-89	45	45	1000	40/250	150/2	0.50	500/50	50	F
BCX71G	SOT-23	45	45	200	120/220	2/5	0.25	10/0.5	180	F
BCX71H	SOT-23	45	45	200	180/310	2/5	0.25	10/0.5	180	F
BCX71J	SOT-23	45	45	200	250/460	2/5	0.25	10/0.5	180	F
BCX71K	SOT-23	45	45	200	380/630	2/5	0.25	10/0.5	180	F
BC807-16	SOT-23	45	50	500	100/250	100/1	0.70	500/50	100	F
BC807-25	SOT-23	45	50	500	160/400	100/1	0.7	500/50	100	F
BC807-40	SOT-23	45	50	500	250/600	100/1	0.7	500/50	100	F
BC857A	SOT-23	45	50	100	125/250	2/5	0.30	10/0.5	150	F
BC857B	SOT-23	45	50	100	220/475	2/5	0.3	10/0.5	150	F
BC857C	SOT-23	45	50	100	420/800	2/5	0.3	10/0.5	150	F
BCW69	SOT-23	45	50	100	120/260	2/5	0.30	10/0.5	150	F
BCW70	SOT-23	45	50	100	215/500	2/5	0.30	10/0.5	150	F
BCP52	SOT-223	60	60	1000	40/250	150/2	0.50	500/50	50	R
BCX52	SOT-89	60	60	1000	40/250	150/2	0.50	500/50	50	F
PMBTA55	SOT-23	60	60	500	50/-	100/1	0.25	100/10	50	F
PMBT2907A	SOT-23	60	60	600	100/300	150/10	0.4	150/15	>200	F
PXT2907A	SOT-89	60	60	600	100/300	150/10	0.4	150/15	>200	F
PZT2907A	SOT-223	60	60	600	100/300	150/10	0.4	150/15	>200	R
BCW89	SOT-23	60	80	100	120/260	2/5	0.30	10/0.5	150	F
BC856A	SOT-23	65	80	100	220/475	2/5	0.3	10/0.5	150	F
BC856B	SOT-23	65	80	100	125/250	2/5	0.30	10/0.5	150	F
PMBTA56	SOT-23	80	80	500	50/-	100/1	0.25	100/10	50	F
BCP53	SOT-223	80	100	1000	40/250	150/2	0.50	500/50	50	R
BCX53	SOT-89	80	100	1000	40/250	150/2	0.50	500/50	50	F

PINOUT DIAGRAMS









	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT F: SOT-23	E	B	C	—
PINOUT F: SOT-89	E	B	C	—
PINOUT G: SOT-143	B,C_2	C_1	E_1	E_2
PINOUT R: SOT-223	B	C	E	C

MARKING CODES

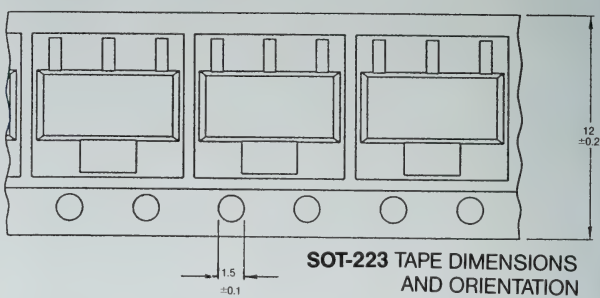
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BC807-16	5A	BC858C	3L	BCW69	H1	PMBT2907A	2F
BC807-25	5B	BC869	CEC	BCW70	H2	PMBT3906	2A
BC807-40	5C	BCP51	*	BCW89	H3	PMBT4403	2T
BC808-16	5E	BCP52	*	BCX17	T1	PMBTA55	2H
BC808-25	5F	BCP53	*	BCX18	T2	PMBTA56	2G
BC808-40	5G	BCP69	*	BCX51	AA	PMBTA70	2C
BC856A	3A	BCV62	C91	BCX52	AE	PXT2907A	2F
BC856B	3B	BCW29	C1	BCX53	AH	PXT3906	2A
BC857A	3E	BCW30	C2	BCX71G	BG	PXT4403	2T
BC857B	3F	BCW61A	BA	BCX71H	BH	PZT2907A	*
BC857C	3G	BCW61B	BB	BCX71J	BJ		
BC858A	3J	BCW61C	BC	BCX71K	BK		
BC858B	3K	BCW61D	BD	PMBT2907	2B		

*See individual device data sheet

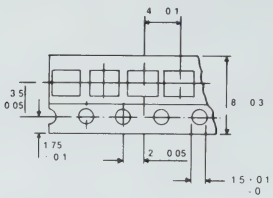
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

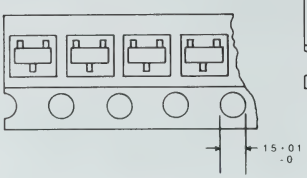
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



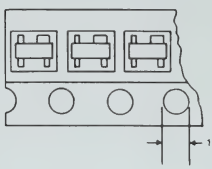
SOT-223 TAPE DIMENSIONS AND ORIENTATION



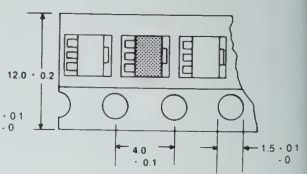
SOT-23 and SOT-143
TAPE DIMENSIONS



SOT-23
ORIENTATION

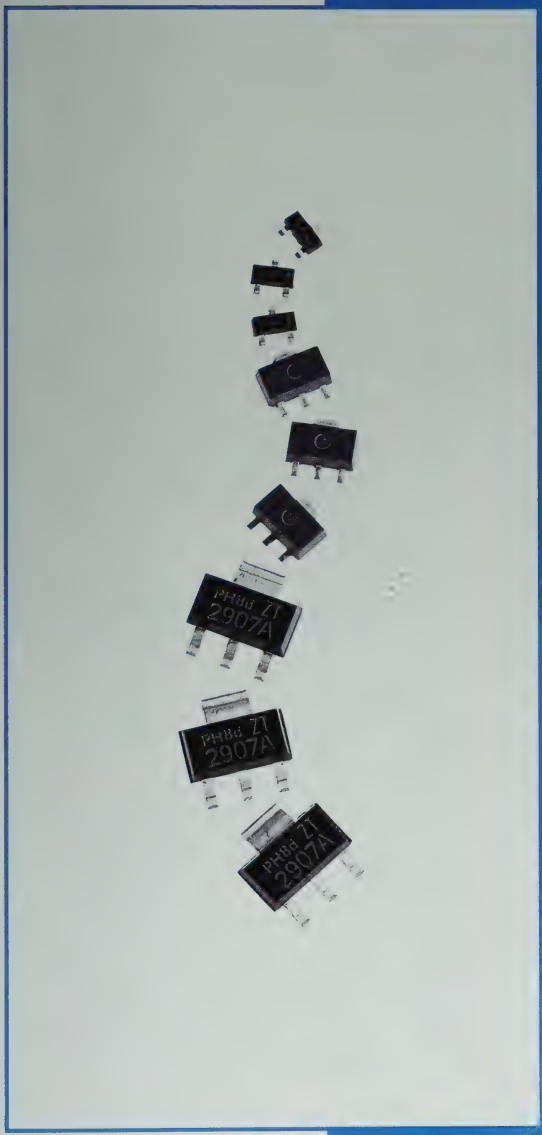


SOT-143
ORIENTATION



SOT-89
TAPE DIMENSIONS AND ORIENTATION

SMD SWITCHING TRANSISTORS



DESCRIPTION

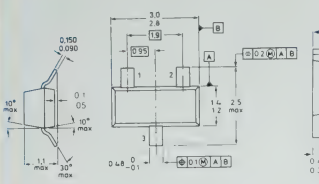
■ Philips Components switching transistors are fabricated using gold doping to reduce the minority carriers in the junction, thus improving the transition performance of the devices. All are specified for turn-off and turn-on times given resistive loaded circuits. These types are offered in a variety of surface mount transistor packages including the SOT-23, SOT-89 and the new SOT-223, which provide the designer options for addressing various power requirements, circuit board substrate materials, and assembly processing techniques.

FEATURES

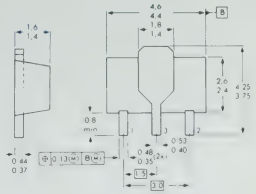
- Transition times under 12ns for high-speed saturated switching
- Complementary NPN and PNP pairs available
- Up to 1 Watt power dissipation rating @ 60°C on epoxy printed circuit boards with the new SOT-223 package
- Medium power devices offered in the SOT-89 package
- Continuous current ratings up to 1 A available

MECHANICAL DATA

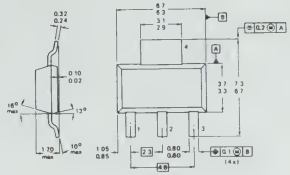
(Dimensions in mm)



SOT-23 TOP VIEW



SOT-89 BOTTOM VIEW

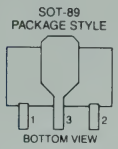


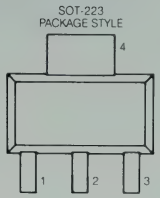
SOT-223

ELECTRICAL SPECIFICATIONS

TYPE	PACKAGE	RATINGS			h_{FE}		$V_{CE(sat)}$		t(max)		PINOUT
		V_{CEO} V	V_{CBO} V	I_C mA	min./max. at I_C/V_{CE} mA/V		max. at I_C/I_B V	mA/mA	on/off at I_C/I_B ns	mA/mA	
NPN											
BSV52	SOT-23	12	20	100	40/120	10/1	0.4	50/15	12/18	10/3	F
PMBT2369	SOT-23	15	40	500	40/120	10/1	.25	10/1	12/18	10/3	F
BSR13	SOT-23	30	60	800	100/300	150/10	1.6	500/50	35/285	150/-	F
PMBT2222	SOT-23	30	60	600	100/300	150/10	0.4	150/15	35/285	150/15	F
PXT4401	SOT-89	40	40	600	100/300	150/1	0.4	150/15	35/255	150/15	F
PMBT4401	SOT-23	40	50	600	100/300	150/1	0.4	150/15	35/255	150/15	F
BSR17	SOT-23	40	60	200	50/150	10/1	0.3	50/5	70/225	10/1	F
BSR17A	SOT-23	40	60	200	100/300	10/1	0.3	50/5	70/250	10/1	F
BSR14	SOT-23	40	75	800	100/300	150/10	1.6	500/50	35/285	150/1	F
PMBT2222A	SOT-23	40	75	600	100/300	150/10	0.3	150/15	35/285	150/15	F
PXT2222A	SOT-89	40	75	600	100/300	150/10	0.3	150/15	35/285	150/15	F
PZT2222A	SOT-223	40	75	600	100/300	150/10	0.3	150/15	35/285	150/15	R
BSP40	SOT-223	60	70	1000	40/120	100/5	0.5	500/50	250/1000	100/5	R
BSP41	SOT-223	60	70	1000	100/300	100/5	0.5	500/50	250/1000	100/5	R
BSR40	SOT-89	60	70	1000	40/120	100/5	0.5	500/50	250/1000	100/5	F
BSR41	SOT-89	60	70	1000	100/5	100/5	0.5	500/50	250/1000	100/5	F
BSP42	SOT-223	80	90	1000	40/120	100/5	0.5	500/50	250/1000	100/5	R
BSP43	SOT-223	80	90	1000	100/300	100/5	0.5	500/50	250/1000	100/5	R
BSR42	SOT-89	80	90	1000	40/120	100/5	0.5	500/50	250/1000	100/5	F
BSR43	SOT-89	80	90	1000	100/300	100/5	0.5	500/50	250/1000	100/5	F
BSS64	SOT-23	80	120	100	20/80	10/1	0.2	50/15	/1000	15/1	F
PNP											
PMBT3640	SOT-23	12	12	80	20/-	50/1	0.6	50/5	25/35	10/5	F
BSR12	SOT-23	15	15	100	30/120	50/1	0.45	100/10	20/30	30/3	F
BSR18	SOT-23	40	40	200	50/150	10/1	0.40	50/5	70/250	10/1	F
BSR18A	SOT-23	40	40	200	100/300	10/1	0.4	50/5	70/300	10/1	F
PMBT4403	SOT-23	40	40	600	100/300	150/2	0.4	150/15	35/255	150/15	F
PXT4403	SOT-89	40	40	600	100/300	150/2	0.4	150/15	35/255	150/15	F
BSR15	SOT-23	40	60	600	100/300	150/10	1.6	500/50	45/100	150/15	F
PMBT2907	SOT-23	40	60	600	100/300	150/10	0.4	150/15	45/100	150/15	F
BSR16	SOT-23	60	60	600	100/300	150/10	1.6	500/50	45/100	150/15	F
PMBT2907A	SOT-23	60	60	600	100/300	150/10	0.4	150/15	45/100	150/15	F
PXT2907A	SOT-89	60	60	600	100/300	150/10	0.4	150/15	45/100	150/15	F
PZT2907A	SOT-223	60	60	600	100/300	150/10	0.4	150/15	45/100	150/15	R
BSP30	SOT-223	60	70	1000	40/120	100/5	0.5	500/50	500/650	100/5	R
BSP31	SOT-223	60	70	1000	100/300	100/5	0.5	500/50	500/650	100/5	R
BSR30	SOT-89	60	70	1000	40/120	100/5	0.5	500/50	500/650	100/5	F
BSR31	SOT-89	60	70	1000	100/300	100/5	0.5	500/50	500/650	100/5	F
BSP32	SOT-223	80	90	1000	40/120	100/5	0.5	500/50	500/650	100/5	R
BSP33	SOT-223	80	90	1000	100/300	100/5	0.5	500/50	500/650	100/5	R
BSR32	SOT-89	80	90	1000	40/120	100/5	0.5	500/50	500/650	100/5	F
BSR33	SOT-89	80	90	1000	100/300	100/5	0.5	500/50	500/650	100/5	F
BSS63	SOT-23	100	110	100	30/-	25/1	0.25	25/2.5	–	–	F

PINOUT DIAGRAMS





	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT F: SOT-23	E	B	C	—
PINOUT F: SOT-89	E	B	C	—
PINOUT R: SOT-223	B	C	E	C

MARKING CODES

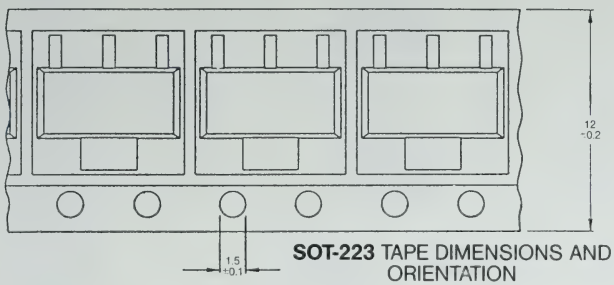
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BSP30	*	BSR15	T7	BSR41	AR2	PMBT3640	2J
BSP31	*	BSR16	T8	BSR42	AR3	PMBT4401	2X
BSP32	*	BSR17	U9	BSR43	AR4	PMBT4403	2T
BSP33	*	BSR17A	U92	BSS63	BM	PXT2222A	1P
BSP40	*	BSR18	T9	BSS64	AM	PXT2907A	2F
BSP41	*	BSR18A	T92	BSV52	B2	PXT4401	2X
BSP42	*	BSR30	BR1	PMBT2222	1B	PXT4403	2T
BSP43	*	BSR31	BR2	PMBT2222A	1P	PZT2222A	*
BSR12	B5	BSR32	BR3	PMBT2369	1J	PZT2907A	*
BSR13	U7	BSR33	BR4	PMBT2907	2B		
BSR14	U8	BSR40	AR1	PMBT2907A	2F		

*See individual device data sheet.

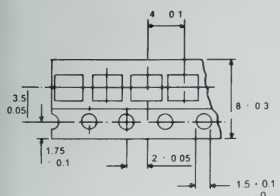
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

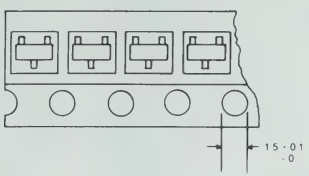
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



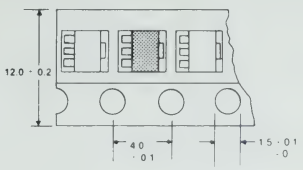
SOT-223 TAPE DIMENSIONS AND ORIENTATION



SOT-23
TAPE DIMENSIONS

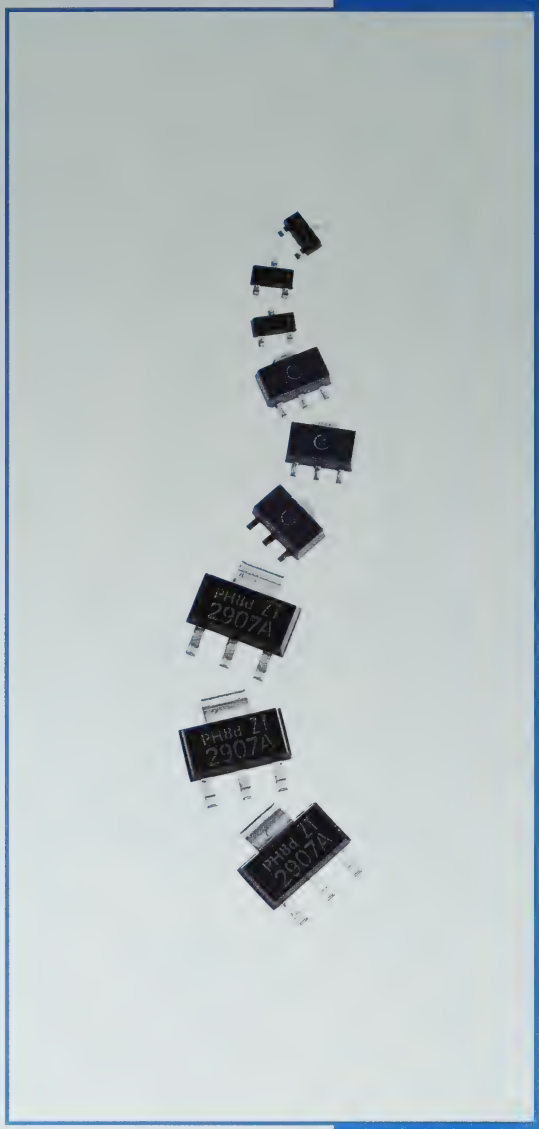


SOT-23
ORIENTATION



SOT-89
TAPE DIMENSIONS
AND ORIENTATION

SMD DARLINGTON TRANSISTORS



DESCRIPTION

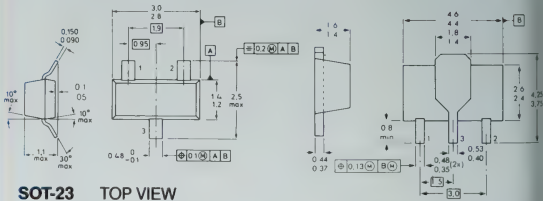
■ Philips Components Darlington transistors provide high input impedance and thus high gain by virtue of two series-integrated transistors on a single chip. High current versions are excellent for industrial switching applications such as driving print hammers, solenoids, relays and lamps. Lower current types are ideal for preamplifier input applications. Darlington transistors are offered in a choice of surface mount packages to address various power requirements, substrates and soldering options available to the designer.

FEATURES

- Gains up to 20,000
- High current types handle up to 90V breakdown and 1.5A surge
- Complementary NPN and PNP devices
- SOT-89 for medium power applications
- SOT-223 for 1W power at 60°C on printed circuit boards

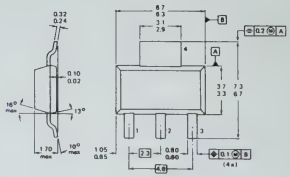
MECHANICAL DATA

(Dimensions in mm)



SOT-23 TOP VIEW

SOT-89 BOTTOM VIEW

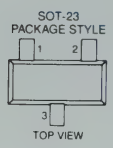


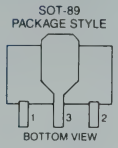
SOT-223

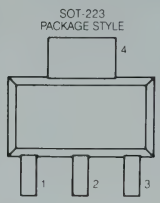
ELECTRICAL SPECIFICATIONS

TYPE	PACKAGE	RATINGS			h_{FE}		$V_{CE(sat)}$		f_T	PINOUT
		V_{CEO} V	V_{CBO} V	I_C mA	min./max. at I_C/V_{CE} mA/V		max. at I_C/I_B V	mA/mA	typ MH_z	
NPN										
PMBTA13	SOT-23	20	30	300	10,000	100/5	1.5	100/0.1	125	F
PZTA13	SOT-223	20	30	300	10,000	100/5	1.5	100/0.1	125	R
PMBTA14	SOT-23	30	30	300	20,000	100/5	1.5	100/0.1	125	F
PXTA14	SOT-89	30	30	300	20,000	100/5	1.5	100/0.1	125	F
PZTA14	SOT-223	30	30	300	20,000	100/5	1.5	100/0.1	125	R
BCV27	SOT-23	30	40	300	20,000	100/5	1.0	100/0.1	100	F
PMBT6427	SOT-23	40	40	500	14,000	500/5	1.5	500/0.5	–	F
BSP50	SOT-223	60	45	500	2,000	500/10	1.3	500/0.5	–	R
BST50	SOT-89	60	45	500	2,000	500/10	1.3	500/0.5	–	F
BST51	SOT-89	80	60	500	2,000	500/1	1.3	500/0.5	–	F
BSP52	SOT-223	90	80	500	2,000	500/5	1.3	500/0.5	–	R
BST52	SOT-89	90	80	500	2,000	500/5	1.3	500/0.5	–	F
PNP										
PMBTA63	SOT-23	30	30	300	10,000	100/5	1.5	100/0.1	125	F
PMBTA64	SOT-23	30	30	300	20,000	100/5	1.5	100/0.1	125	F
PXTA64	SOT-89	30	30	300	20,000	100/5	1.5	100/0.1	125	F
PZTA63	SOT-223	30	30	300	10,000	100/5	1.5	100/0.1	125	R
PZTA64	SOT-223	30	30	300	20,000	100/5	1.5	100/0.1	125	R
BCV26	SOT-23	30	40	300	20,000	100/5	1.0	100/0.1	100	F
BSP60	SOT-223	60	45	500	2,000	500/10	1.3	500/0.5	–	R
BST60	SOT-89	60	45	500	2,000	500/10	1.3	500/0.5	–	F
BSP61	SOT-223	80	60	500	2,000	500/10	1.3	500/0.5	–	R
BST61	SOT-89	80	60	500	2,000	500/10	1.3	500/0.5	–	F
BSP62	SOT-223	90	80	500	2,000	500/10	1.3	500/0.5	–	R
BST62	SOT-89	90	80	500	2,000	500/10	1.3	500/0.5	–	F

PINOUT DIAGRAMS







	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT F: SOT-23	E	B	C	—
PINOUT F: SOT-89	E	B	C	—
PINOUT R: SOT-223	B	C	E	C

MARKING CODES

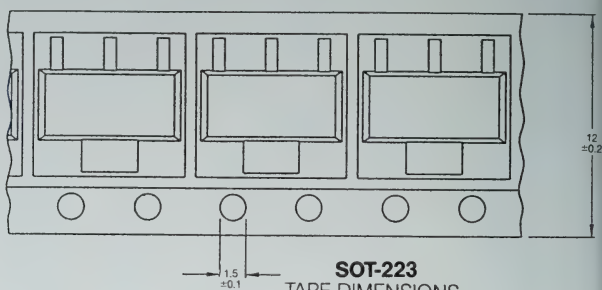
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BCV26	FD	BSP62	*	BST62	BS3	PXTA14	1N
BCV27	FF	BST50	AS1	PMBT6427	1V	PXTA64	2V
BSP50	*	BST51	AS2	PMBTA13	1M	PZTA13	*
BSP52	*	BST52	AS3	PMBTA14	1N	PZTA14	*
BSP60	*	BST60	BS1	PMBTA63	2U	PZTA63	*
BSP61	*	BST61	BS2	PMBTA64	2V	PZTA64	*

*See individual device data sheet

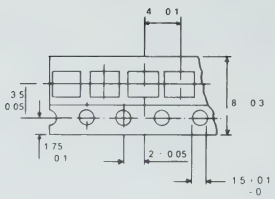
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

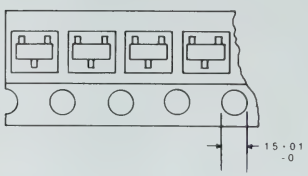
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



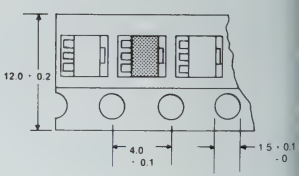
SOT-223
TAPE DIMENSIONS
AND ORIENTATION



SOT-23
TAPE DIMENSIONS



SOT-23
ORIENTATION



SOT-89
TAPE DIMENSIONS
AND ORIENTATION

HIGH FREQUENCY SMD TRANSISTORS

DESCRIPTION

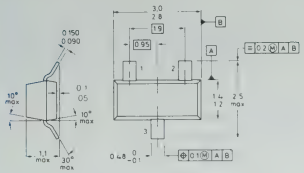
■ Philips Components high-frequency transistors fill the gap between general purpose transistors and broadband transistors by offering transition frequencies from a few hundred megahertz to about 1 gigahertz. Applications include IF preamplifiers, oscillators for VHF/UHF tuners, and RF stages for FM front ends.

FEATURES

- Typical feedback capacitances as low as 0.1 pF
- Transition frequencies up to 1.3 GHz
- Typical noise figures from 2-4.5 dB
- Complementary NPN and PNP devices

MECHANICAL DATA

(Dimensions in mm)

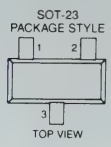


SOT-23 TOP VIEW

ELECTRICAL SPECIFICATIONS

TYPE	PACKAGE	RATINGS			h_{FE}		NF		f_T	C_{re}	PINOUT
		V_{CEO} V	V_{CBO} V	I_C mA	min./max. at I_C/V_{CE} mA/V		typ. at I_C dB	mA	typ. MH_z	typ. pF	
NPN											
BFS18	SOT-23	20	30	30	35/125	1/10	4	1	200	0.85	F
BFS19	SOT-23	20	30	30	65/225	1/10	4	1	260	0.85	F
BFS20	SOT-23	20	30	25	40/-	7/10	—	—	450	0.35	F
BF840	SOT-23	40	40	25	—	—	1.5	1	380	0.3	F
BF841	SOT-23	40	40	25	—	—	2.0	1	380	0.3	F
PNP											
BF579	SOT-23	20	20	25	20/-	10/10	4.5	10	1350	0.46	F
BF536	SOT-23	30	30	25	25/-	1/10	5	1	350	—	F
BF767	SOT-23	30	30	20	15/-	3/10	4	3	900	0.3	F
BF824	SOT-23	30	30	25	—	—	3	2	440	0.1	F
BF660	SOT-23	30	40	25	30/-	3/10	—	—	650	0.65	F
BF569	SOT-23	35	40	30	25/-	3/10	4.5	3	900	0.33	F
BF550	SOT-23	40	40	25	50/-	1/10	2	1	325	0.5	F

PINOUT DIAGRAM



	PIN 1	PIN 2	PIN3
PINOUT F: SOT-23	E	B	C

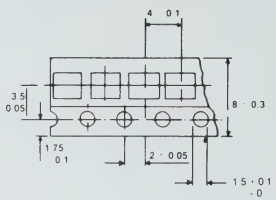
MARKING CODES

Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BF536	G3	BF579	LJ	BF824	F8	BFS18	F1
BF550	LA	BF660	LE	BF840	NC	BFS19	F2
BF569	LH	BF767	G9	BF841	ND	BFS20	G1

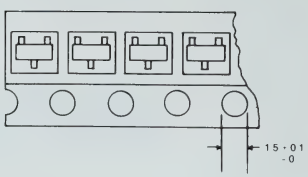
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13

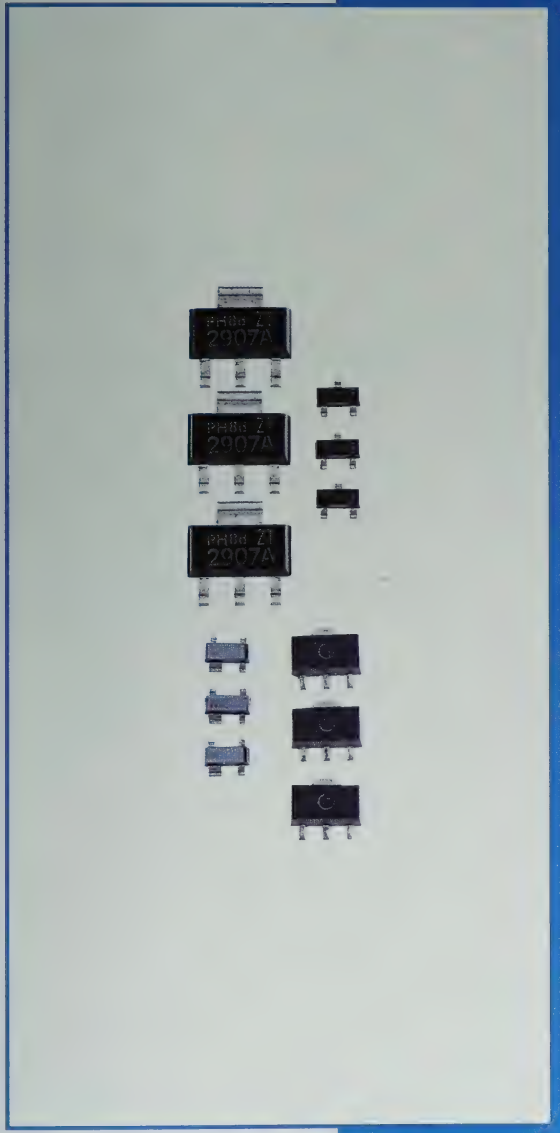


SOT-23
TAPE DIMENSIONS



SOT-23
ORIENTATION

BROADBAND SMD TRANSISTORS



DESCRIPTION

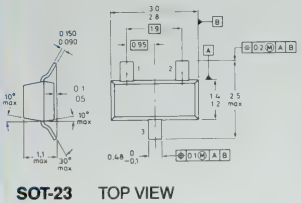
■ Philips Components broadband transistors are the result of leading-edge technology dedicated to expanding performance and selection in the wideband arena. The devices are ideal amplifiers for VHF, UHF, and microwave frequencies up to 1 GHz. Typical applications are in satellite and cable television and fiber optic repeaters.

FEATURES

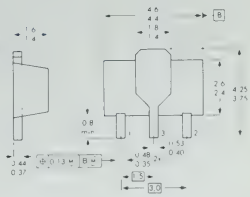
- Typical transition frequencies up to 12 GHz
- Excellent output voltage capabilities—power gains of 16 dB
- Typical noise figures as low as 2.5 dB
- Collector current ratings as high as 150 mA D.C.
- Complementary NPN and PNP devices
- SOT-223 for 1 W power at 60°C on printed circuit boards

MECHANICAL DATA

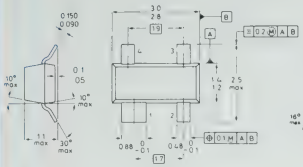
(Dimensions in mm)



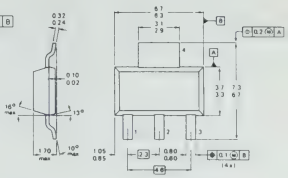
SOT-23 TOP VIEW



SOT-89 BOTTOM VIEW



SOT-143 TOP VIEW

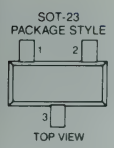


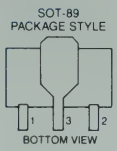
SOT-223

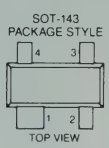
ELECTRICAL SPECIFICATIONS

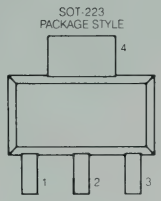
TYPE	PACKAGE	RATINGS			h_{FE}		NF		f_T	C_{re}	PINOUT
		V_{CEO} V	V_{CBO} V	I_C mA	min./max. at I_C/V_{CE} mA/V		typ. at I_C dB	mA	typ. GH_z	typ. pF	
NPN											
BFT25	SOT-23	5	8	6.5	20/-	1/1	3.8	1	2.3	0.45	F
BFR53	SOT-23	10	18	50	25/-	50/5	5.0	2	2.0	0.9	F
BFG67	SOT-143	10	20	50	60/-	15/5	2.5	5	7.5	0.5	Q
BFG97	SOT-223	10	20	100	25/90	70/10	–	–	5.5	1.0	S
BFQ67	SOT-23	10	20	50	100typ	15/5	2.5	5	7.5	0.5	F
BFR93	SOT-23	12	15	35	25/-	30/5	1.9	2	5.0	0.8	F
BFR93A	SOT-23	12	15	35	40/-	3-/5	1.6	4	5.0	0.6	F
BFQ19	SOT-89	15	20	75	25/-	75/10	3.3	50	5.0	1.3	F
BFR92	SOT-23	15	20	25	25/-	14/10	2.4	2	5.0	0.7	F
BFR92A	SOT-23	15	20	25	40/-	14/10	1.8	4	5.0	0.35	F
BFQ18A	SOT-89	15	20	150	25/-	100/10	–	–	3.6	1.2	F
BFS17	SOT-23	15	25	25	20/150	2/1	4.5	2	1.3	0.65	F
BFS17A	SOT-23	15	25	35	20/-	2/1	2.5	2	2.8	0.6	F
BFG17A	SOT-143	15	25	25	20/150	2/1	2.5	2	2.8	0.6	Q
BFG35	SOT-223	18	25	150	25/140	100/10	–	–	4.0	1.2	S
BFQ17	SOT-89	25	40	150	25/-	150/5	–	–	1.2	1.9	F
BFG16A	SOT-223	25	40	300	25/-	150/5	6 max	30	1.2	1.7	S
BFG33	SOT-143	7	9	20	25/-	14/5	2.5	5	12	–	Q
BFG92A	SOT-143	15	20	25	40/-	14/10	–	–	5	0.35	Q
BFG93A	SOT-143	12	15	35	40/-	30/5	–	–	6	0.6	Q
BFG135	SOT-223	15	25	150	80/-	100/10	–	–	7	1.2	S
BFG197	SOT-143	10	20	100	40/-	50/5	–	–	7.5	0.85	Q
BFG198	SOT-223	10	20	100	40/-	50/5	–	–	8	0.8	S
BFR106	SOT-23	15	20	100	25/-	20/8	–	–	3.3	1.2	
PNP											
BFT93	SOT-23	12	15	35	20/-	30/5	2.4	2	5	1.0	F
BFT92	SOT-23	15	20	25	20/-	14/10	2.7	2	5	0.7	F
BFQ149	SOT-89	15	20	75	20/-	50/10	3.75	50	4.4	0.35	F
BFG31	SOT-223	15	20	100	25/-	70/10	–	–	5	1.6	S
BFG55	SOT-223	18	25	150	25 typ	100/10	–	–	4	1.7	S

PINOUT DIAGRAMS









	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT F: SOT-23	E	B	C	—
PINOUT F: SOT-89	E	B	C	—
PINOUT Q: SOT-143	C	B	E	E
PINOUT S: SOT-223	E	B	E	C

MARKING CODES

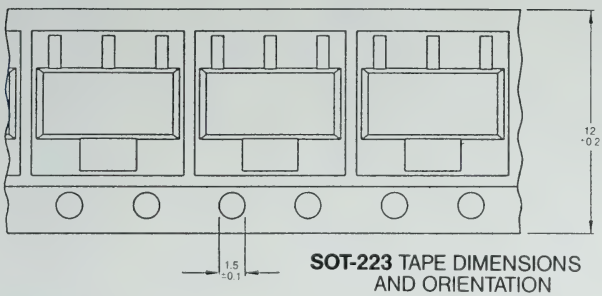
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BFG16A	*	BFG93A	R8	BFQ67	V2	BFS17	E1
BFG17A	E6	BFG97	*	BFQ149	V2	BFS17A	E2
BFG31	*	BFG135	*	BFR53	N1	BFT25	V1
BFG33	V6	BFG197	V5	BFR92	P1	BFT92	W1
BFG35	*	BFG198	*	BFR92A	P2	BFT93	X1
BFG55	*	BFQ17	FA	BFR93	R1		
BFG67	V8	BFQ18A	FF	BFR93A	R2		
BFG92A	P8	BFQ19	FB	BFR106	R7		

*See individual device data sheet

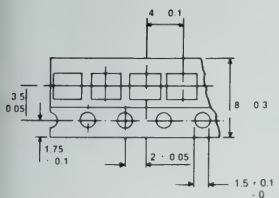
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

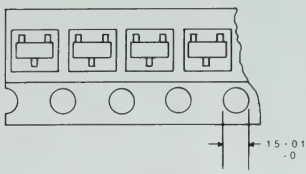
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



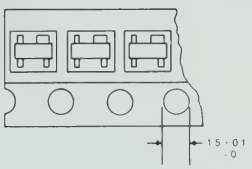
SOT-223 TAPE DIMENSIONS AND ORIENTATION



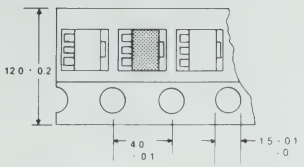
SOT-23 and SOT-143
TAPE DIMENSIONS



SOT-23
ORIENTATION



SOT-143
ORIENTATION



SOT-89
TAPE DIMENSIONS AND ORIENTATION

LOW NOISE SMD TRANSISTORS

DESCRIPTION

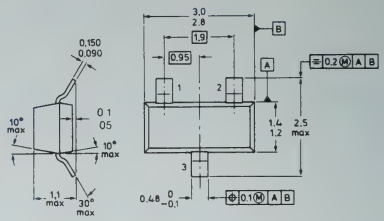
■ Philips Components low-noise transistors are optimized for operation on low level signals as required by audio and other amplifier circuits. All have guaranteed low-current specifications for noise, gain and saturation voltages.

FEATURES

- Typical noise figures as low as 1 dB at 200 μA
- DC gain specified at test limits as low as 10 μA
- Complementary NPN and PNP devices
- Compatible with wave or reflow soldering

MECHANICAL DATA

(Dimensions in mm)

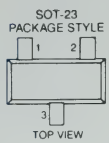


SOT-23 TOP VIEW

ELECTRICAL SPECIFICATIONS

TYPE	PACKAGE	RATINGS			NF		h_{FE}		$V_{CE(sat)}$		f_T	PINOUT
		V_{CEO} V	V_{CBO} V	I_C mA	typ. at I_C dB	μA	min./max. at I_C/V_{CE}	mA/V	max. at I_C/I_B V	mA/mA	typ. MH_z	
NPN												
PMBT5089	SOT-23	25	30	50	1.2	100	400/-	10/5	0.5	10/1	100	F
BC849B	SOT-23	30	30	200	1.2	200	200/450	2/5	0.25	10/0.5	300	F
BC849C	SOT-23	30	30	200	1.2	200	420/800	2/5	0.25	10/0.5	300	F
PMBT5088	SOT-23	30	35	50	1.0	100	300/-	10/5	0.5	10/1	100	F
BCF32	SOT-23	32	32	100	1.2	200	200/450	2/5	0.25	10/0.5	300	F
BCF33	SOT-23	32	32	100	1.2	200	420/800	2/5	0.25	10/0.5	300	F
BC850B	SOT-23	45	50	200	1.0	200	200/450	2/5	0.25	10/0.5	300	F
BC850C	SOT-23	45	50	200	1.0	200	420/800	2/5	0.25	10/0.5	300	F
BCF81	SOT-23	45	50	100	1.2	200	420/800	2/5	0.25	10/0.5	300	F
PMBT6429	SOT-23	45	55	200	0.5	100	500/-	10/5	0.2	10/0.5	100	F
PMBT6428	SOT-23	50	60	200	0.5	100	250/-	10/5	0.2	10/0.5	100	F
PNP												
BC859A	SOT-23	30	30	100	1.2	200	125/250	2/5	0.3	10/0.5	150	F
BC859B	SOT-23	30	30	100	1.2	200	220/475	2/5	1.0	10/0.5	150	F
BC859C	SOT-23	30	30	100	1.2	200	420/800	2/5	0.3	10/0.5	150	F
BCF29	SOT-23	32	32	100	1.0	200	120/260	2/5	0.3	10/0.5	150	F
BCF30	SOT-23	32	32	100	1.0	200	215/500	2/5	0.3	10/0.5	150	F
BC860A	SOT-23	45	50	100	1.0	200	125/250	2/5	0.3	10/0.5	150	F
BC860B	SOT-23	45	50	100	1.0	200	220/475	2/5	0.3	10/0.5	150	F
BC860C	SOT-23	45	50	100	1.0	200	420/800	2/5	0.3	10/0.5	150	F
BCF70	SOT-23	45	50	100	1.0	200	215/500	2/5	0.3	10/0.5	150	F
PMBT5086	SOT-23	50	50	50	1.2	100	150/-	10/5	0.3	10/1	100	F
PMBT5087	SOT-23	50	50	50	1.0	100	250/-	10/5	0.3	10/1	100	F

PINOUT DIAGRAM



	PIN 1	PIN 2	PIN 3
PINOUT F: SOT-23	E	B	C

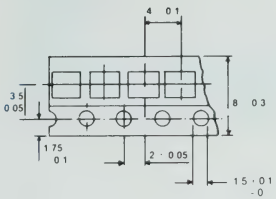
MARKING CODES

Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BC849B	2B	BC859C	4C	BCF32	D7	PMBT5088	1Q
BC849C	2C	BC860A	4E	BCF33	D8	PMBT5089	1R
BC850B	2F	BC860B	4F	BCF70	H7	PMBT6428	1K
BC850C	2G	BC860C	4G	BCF81	K9	PMBT6429	1L
BC859A	4A	BCF29	C7	PMBT5086	2P		
BC859B	4B	BCF30	C8	PMBT5087	2Q		

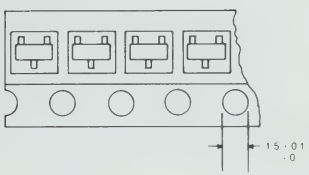
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13

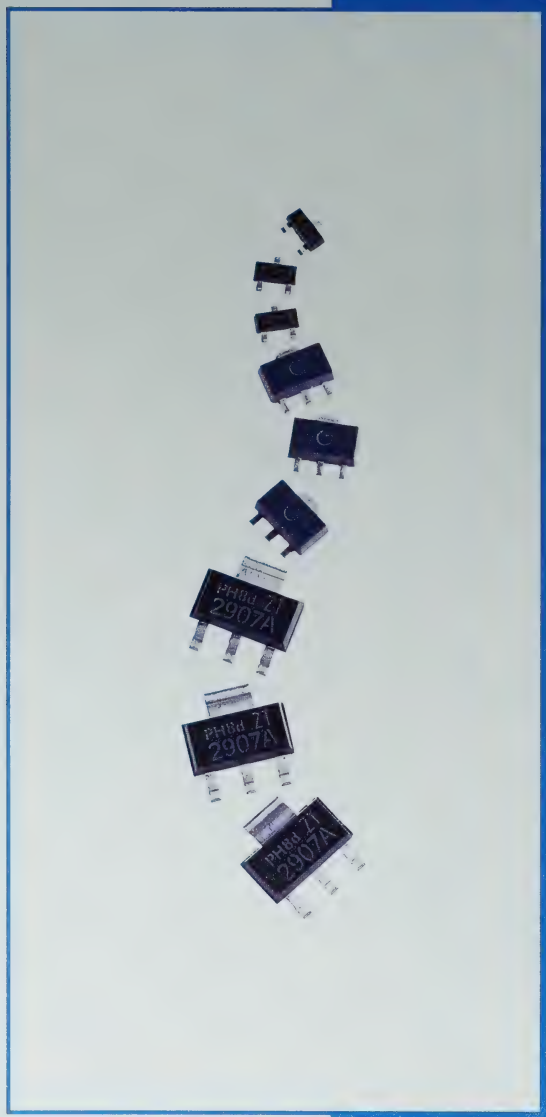


SOT-23
TAPE DIMENSIONS



SOT-23
ORIENTATION

HIGH VOLTAGE SMD TRANSISTORS



DESCRIPTION

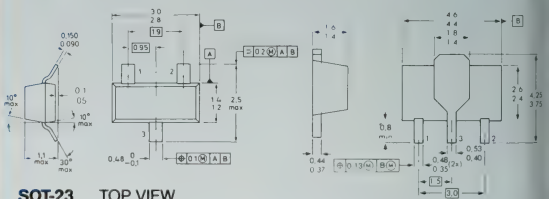
■ Philips Components produces a variety of chip geometries in order to offer high voltage transistors with a broad range of current handling capabilities. The result is a device which not only fulfills high voltage application needs, but precisely matches current requirements without wasting silicon and increasing costs. High voltage transistors are offered in a choice of surface mount packages, allowing matching of power dissipation to circuit, substrate and soldering requirements.

FEATURES

- Reverse breakdown voltages up to 400V
- Continuous current ratings from 20 mA to 1A
- Complementary NPN and PNP devices
- SOT-89 for medium power applications
- SOT-223 for 1W power at 60°C on printed circuit boards

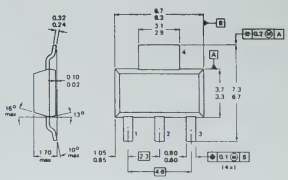
MECHANICAL DATA

(Dimensions in mm)



SOT-23 TOP VIEW

SOT-89 BOTTOM VIEW

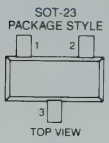


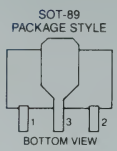
SOT-223

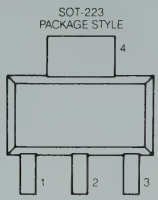
ELECTRICAL SPECIFICATIONS

TYPE	PACKAGE	RATINGS			h_{FE}		$V_{CE(sat)}$		f_T	PINOUT
		V_{CEO} V	V_{CBO} V	I_C mA	min./max. at I_C/V_{CE} mA/V		max. at I_C/I_B V	mA/mA	typ. MH_z	
NPN										
BF620	SOT-89	–	300	20	50/-	25/20	0.6	30/5	60	F
BF720	SOT-223	–	300	50	50/-	25/20	0.6	30/5	60	R
BF820	SOT-23	–	300	50	50/-	25/20	0.6	30/5	60	F
BSR19	SOT-23	140	160	600	60/250	10/5	0.25	50/5	100	F
PMBT5550	SOT-23	140	160	600	60/250	10/5	0.15	10/1	200	F
BSR19A	SOT-23	160	180	600	80/250	10/5	0.2	50/5	100	F
PMBT5551	SOT-23	160	180	600	80/250	10/5	0.15	10/1	200	F
PMBTA43	SOT-23	200	200	500	40/-	30/10	0.5	20/2	50	F
PZTA43	SOT-223	200	200	500	40/-	30/10	0.5	20/2	50	R
BF622	SOT-89	250	250	20	50/-	25/20	0.6	30/5	60	F
BF722	SOT-223	250	250	50	50/-	25/20	0.6	30/5	60	R
BF822	SOT-23	250	250	50	50/-	25/20	0.6	30/5	60	F
BSP20	SOT-223	250	300	1000	40/160	30/10	0.5	20/2	50	R
BST40	SOT-89	250	300	1000	40/160	20/10	0.50	50/4	15	F
PMBTA42	SOT-23	300	300	500	40/-	30/10	0.5	20/2	50	F
PZTA42	SOT-223	300	300	500	40/-	30/10	0.5	20/2	50	R
BSP19	SOT-223	350	400	1000	40/160	20/10	0.50	50/4	15	R
BST39	SOT-89	350	400	1000	40/160	20/10	0.50	50/4	15	F
PXTA42	SOT-89	300	300	500	40/1	30/10	0.50	20/2	50	F
PNP										
BF621	SOT-89	–	300	20	50/-	25/20	0.8	30/5	60	F
BF721	SOT-223	–	300	50	50/-	25/20	0.8	30/5	60	R
BF821	SOT-23	–	300	50	50/-	25/20	0.8	30/5	60	F
BF823	SOT-23	50	250	50	50/-	25/20	0.8	30/5	60	F
BSR20	SOT-23	120	130	600	40/180	10/5	0.5	50/5	100	F
BSR20A	SOT-23	150	160	600	60/240	10/5	0.5	50/5	100	F
PMBT5401	SOT-23	150	160	600	60/240	10/5	0.2	10/1	200	F
BF723	SOT-223	200	200	50	50/-	25/20	0.8	30/5	60	R
BSP15	SOT-223	200	200	1000	30/150	50/10	2.5	50/5	15	R
BST15	SOT-89	200	200	1000	30/150	50/10	2.5	50/5	15	F
PMBTA93	SOT-23	200	200	500	25/-	30/10	0.5	20/2	50	F
BF623	SOT-89	200	200	20	25/-	30/10	0.5	20/2	50	F
PZTA93	SOT-223	200	200	500	25/-	30/10	0.5	20/2	50	R
BSP16	SOT-223	300	350	1000	30/120	50/10	2.5	50/5	15	R
BST16	SOT-89	300	350	1000	30/120	50/10	2.0	50/5	15	F
PMBTA92	SOT-23	300	300	500	25/-	30/10	0.5	20/2	50	F
PXTA92	SOT-89	300	300	500	25/-	30/10	0.5	20/2	50	F
PZTA92	SOT-223	300	300	500	25/-	30/10	0.5	20/2	50	R

PINOUT DIAGRAMS







	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT F: SOT-23	E	B	C	—
PINOUT F: SOT-89	E	B	C	—
PINOUT R: SOT-223	B	C	E	C

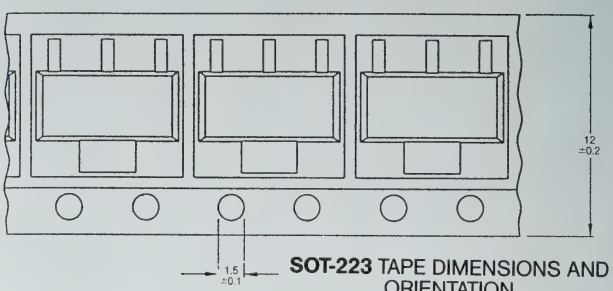
MARKING CODES

Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BF620	DC	BF821	1W	BSR20	T35	PMBTA42	1D
BF621	DF	BF822	1X	BSR20A	T36	PMBTA43	1E
BF622	DA	BF823	1Y	BST15	BT1	PMBTA92	2D
BF623	DB	BSP15	*	BST16	BT2	PMBTA93	2E
BF720	*	BSP16	*	BST39	AT1	PXTA42	1D
BF721	*	BSP19	*	BST40	AT2	PXTA92	2D
BF722	*	BSP20	*	PMBT5401	2L	PZTA42	*
BF723	*	BSR19	U35	PMBT5550	IF	PZTA43	*
BF820	IV	BSR19A	U36	PMBT5551	G1	PZTA92	*
						PZTA93	*

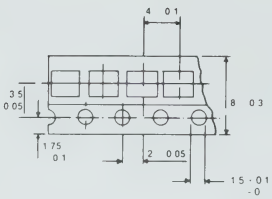
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

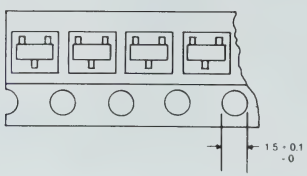
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



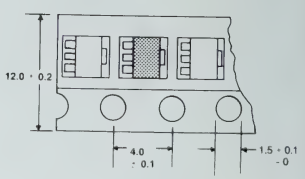
SOT-223 TAPE DIMENSIONS AND ORIENTATION



SOT-23
TAPE DIMENSIONS



SOT-23
ORIENTATION



SOT-89
TAPE DIMENSIONS
AND ORIENTATION

SMD FET's

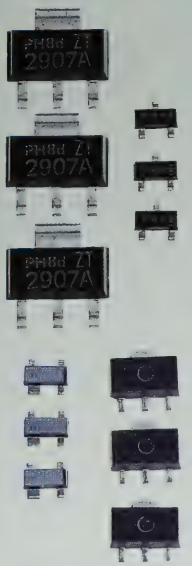
DESCRIPTION

■ Philips Components surface mount range of FET's is the most extensive available, and offers low parasitic capacitance, negligible inductance, and reduced board assembly cost. The three categories of FET's each have its own attributes and applications:

■ Junction FET's (JFET's): Rugged and economical, able to withstand large transient voltages. Extremely high input impedance, low power consumption, and high dynamic range allow for application in all types of low voltage switching and amplification.

■ N-Channel MOSFET's: Available in both single and dual gate configurations. Single gate types are used for switches, choppers, and converters in telecommunications and industrial application. Dual gate devices are especially suitable for VHF/UHF antenna amplifier tuners.

■ Vertical DMOS FET's: Offer medium and high drain-source voltages and source currents. Interdigitated metallization geometries produce lower input capacitances and thus, faster switching times than other types of DMOSFET's. Ideally suited for higher current and voltage applications.

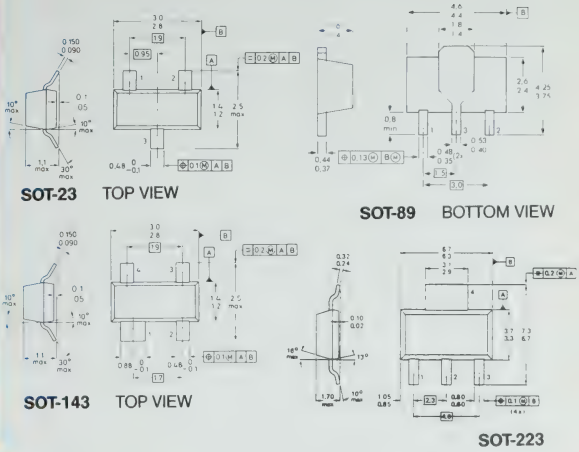


FEATURES

- High input impedance
- Low power consumption
- High dynamic range
- N and P-Channel polarities

MECHANICAL DATA

(Dimensions in mm)



SOT-23 TOP VIEW

SOT-89 BOTTOM VIEW

SOT-143 TOP VIEW

SOT-223

ELECTRICAL SPECIFICATIONS

J FET's

TYPE	PACKAGE	RATINGS V_{DS} V	RATINGS V_{GSO} V	$r_{DS(on)}$ MAX. Ω	$-I_{DSS}$ MIN./MAX. mA	$-V_{(P)GS}$ MAX. V	C_{rs} MAX. pF	PINOUT
N-CHANNEL								
BF510	SOT-23	20	—	—	.07/3.0	0.8	0.4	B
BF511	SOT-23	20	—	—	2.5/7.0	1.5	0.4	B
BF512	SOT-23	20	—	—	6/12	2.2	0.4	B
BF513	SOT-23	20	—	—	10/18	3	0.4	B
BFR30	SOT-23	25	25	—	4/10	5	1.5	A
BFR31	SOT-23	25	25	—	1/5	2.5	1.5	A
BFT46	SOT-23	25	25	—	0.2/1.5	1.0	1.5	A
PMBFJ108	SOT-23	25	25	8	80/-	10	15	A
PMBFJ109	SOT-23	25	25	12	40/-	6	15	A
PMBFJ110	SOT-23	25	25	18	10/-	4	15	A
BFR101A*	SOT-143	30	30	—	0.2/1.5	1.0	—	C
BFR101B*	SOT-143	30	30	—	1/5	2.5	—	C
BSR56	SOT-23	40	40	25	50/-	10	5	A
BSR57	SOT-23	40	40	40	20/100	6	5	A
BSR58	SOT-23	40	40	60	8/80	4	5	A
PMBF4391	SOT-23	40	40	30	50/150	4-10	3.5	A
PMBF4392	SOT-23	40	40	60	25/75	2-5	3.5	A
PMBF4393	SOT-23	40	40	100	5/30	0.53	3.5	A
P-CHANNEL								
PMBFJ174	SOT-23	—	30	85	20/135	10	—	A
PMBFJ175	SOT-23	—	30	125	7/70	6	—	A
PMBFJ176	SOT-23	—	30	250	2/35	4	—	A
PMBFJ177	SOT-23	—	30	300	1.5/20	2.25	—	A
PMBFJ111	SOT-23	40	40	30	20/-	10	3typ.	A
PMBFJ112	SOT-23	40	40	50	5/-	5	3typ.	A
PMBFJ113	SOT-23	40	40	100	2/-	3	3typ.	A

MOSFET'S

TYPE	PACKAGE	MODE	RATINGS V_{DS} V	RATINGS I_D mA	g_{FS} (TYP) mA/V	$V_{(P)GS}$ MAX. V	$R_{DS(on)}$ MAX. AT I_D/V_{GS} Ω	mA/V	PINOUT
N-CHANNEL									
BSD20*	SOT-143	Dpl	10	50	15	-2.0	30	1/10	C
BSS83*	SOT-143	Enh	10	50	15	2.0	45	0.1/10	C
BSD22*	SOT-143	Dpl	20	50	15	-2.0	30	1/10	C

DUAL GATE MOSFET'S

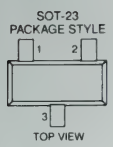
TYPE	PACKAGE	RATINGS V_{DS} V	RATINGS I_D mA	NF typ dB	$-I_{GSS}$ max. nA	I_{DSS} min./max. mA	$-V_{(P)GS}$ max. V	Y_{fs} min. mA/V	C_{rs} typ pF	PINOUT
N-CHANNEL										
BF998	SOT-143	12	30	0.6	50	4/20	2.0	21	.025	E
BF990	SOT-143	18	30	2.8	—	—	1.3	17	0.25	E
BF991	SOT-143	20	20	0.7	50	4/25	2.5	10	0.20	E
BF989	SOT-143	20	30	2.8	50	2/20	2.7	9.5	0.25	E
BF992	SOT-143	20	40	1.2	25	—	1.3	20	.04	E
BF994S	SOT-143	20	40	1.2	25	—	1.3	20	.04	E
BF996S	SOT-143	20	40	1.2	25	—	1.3	20	.04	E
BF997	SOT-143	20	30	1.0	50	2/20	2.0	15	.025	E

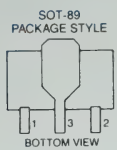
*Includes integrated back-to-back diodes to protect against excessive input voltages.

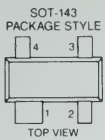
VERTICAL DMOS FET'S

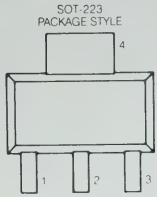
TYPE	PACKAGE	RATINGS V_{DS} V	RATINGS V_{GS} V	RATINGS I_D mA	Y_{FS} typ mA/V	$V_{GS(TH)}$ V	$R_{DS\ (on)}$ max at I_D/V_{GS} Ω	mA/V	PINOUT
N-CHANNEL									
BSP103	SOT-223	35	20	750	170	0.8-2.0	5	300/5	T
BSP105	SOT-223	60	20	500	170	0.8-2.0	5	300/5	T
BSP106	SOT-223	60	15	500	200	0.8-3.0	5	200/10	T
BSP108	SOT-223	80	20	500	300	1.5-3.5	3	500/10	T
BSP110	SOT-223	80	20	325	150	0.8-2.8	7	200/10	T
BST80	SOT-89	80	20	400	300	1.5-3.5	4	500/10	D
BST82	SOT-23	80	20	175	150	1.6-3.5	10	150/5	D
BSP109	SOT-223	90	20	500	170	0.8-2.0	5.3	300/5	T
BST86	SOT-89	180	20	300	250	0.7-2.7	10	15/3	D
BST84	SOT-89	200	20	250	250	0.8-2.8	12	250/10	D
BSP120	SOT-223	200	20	250	250	0.8-2.8	12	250/10	T
BSP121	SOT-223	200	20	300	350	0.8-2.8	6	400/10	T
BSP126	SOT-223	250	20	300	400	0.8-2.0	6	300/10	T
P-CHANNEL									
BSP205	SOT-223	50	20	250	150	1.5-3.5	10	200/10	T
BST122	SOT-89	50	20	250	125	1.5-3.5	6	200/10	D
BST120	SOT-89	60	20	300	200	1.5-3.5	10	200/10	D
BSP206	SOT-223	60	20	300	200	1.5-3.5	6	200/10	T
BSP220	SOT-223	200	20	250	200	0.8-2.24	12	200/10	T
BSS192	SOT-89	200	20	150	200	0.8-2.8	20	200/10	D
BSP225	SOT-223	250	20	250	200	0.8-2.8	15	200/10	T

PINOUT DIAGRAMS









	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT A: SOT-23	S	D	G	—
PINOUT B: SOT-23	D	G	S	—
PINOUT C: SOT-143	S	Sub.	D	G
PINOUT D: SOT-23	S	G	D	—
PINOUT D: SOT-89	S	G	D	—
PINOUT T: SOT-223	G	D	S	D

MARKING CODES

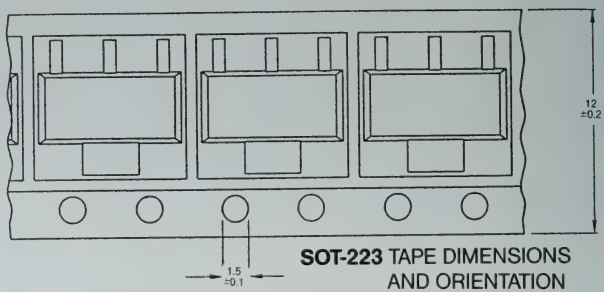
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BF510	S6	BFR31	M2	BSP121	*	PMBF4393	M64
BF511	S7	BFR101A	M97	BSP126	*	PMBFJ108	*
BF512	S8	BFR101B	M98	BSP205	*	PMBFJ109	*
BF513	S9	BFT46	M3	BSP206	*	PMBFJ110	*
BF989	MA	BSD20	M31	BSP220	*	PMBFJ111	M41
BF990	M90	BSD22	M32	BSP225	*	PMBFJ112	M42
BF991	M91	BSP103	*	BSR56	M4	PMBFJ113	M43
BF992	M92	BSP105	*	BSR57	M5	PMBFJ174	6X
BF994S	MG	BSP106	*	BSR58	M6	PMBFJ175	6W
BF996S	MW	BSP108	*	BSS83	M74	PMBFJ176	6S
BF997	MK	BSP109	*	BSS192	KB	PMBFJ177	6Y
BF998	*	BSP110	*	PMBF4391	M62		
BFR30	MI	BSP120	*	PMBF4392	M63		

*See individual device data sheet.

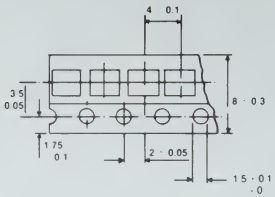
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

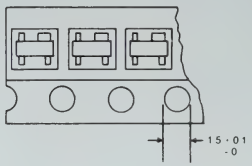
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-89	1K	7	12	TRL
	4K	13	12	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13



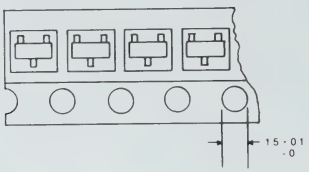
SOT-223 TAPE DIMENSIONS AND ORIENTATION



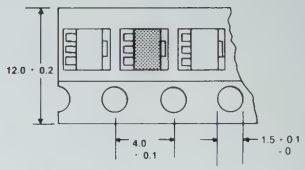
SOT-23 and SOT-143
TAPE DIMENSIONS



SOT-143
ORIENTATION

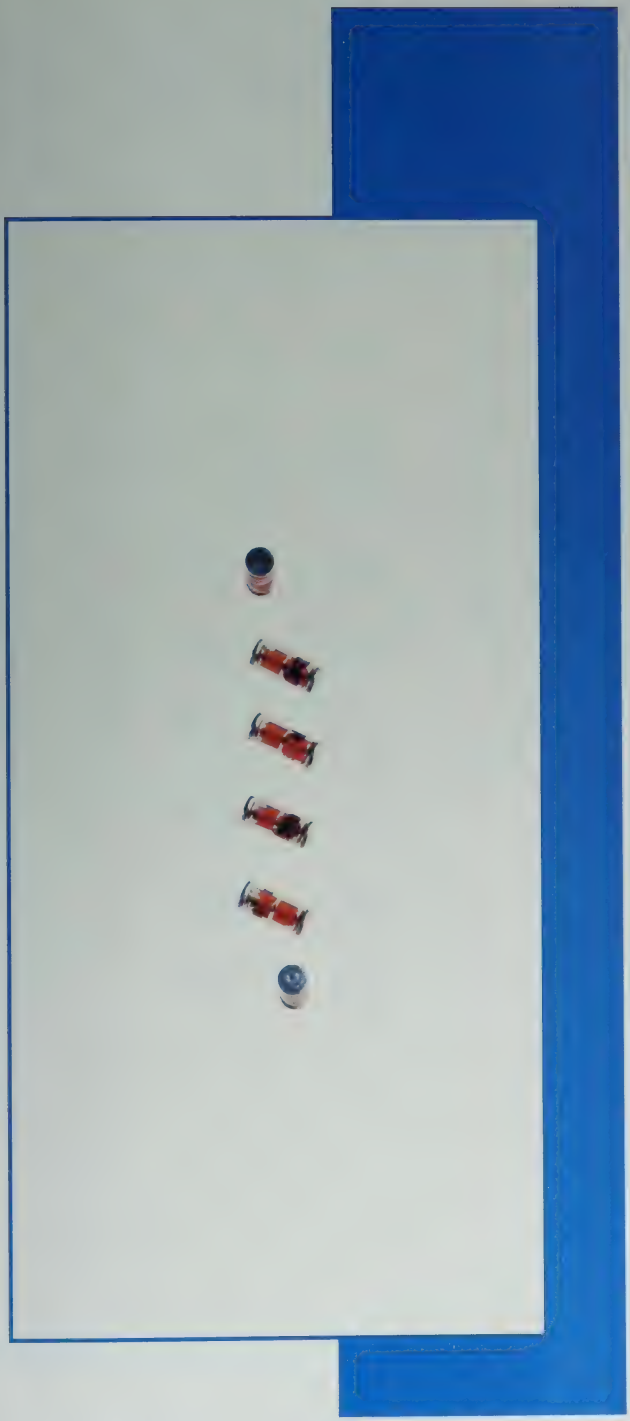


SOT-23
ORIENTATION



SOT-89
TAPE DIMENSIONS AND ORIENTATION

SMD TEMPERATURE SENSORS



DESCRIPTION

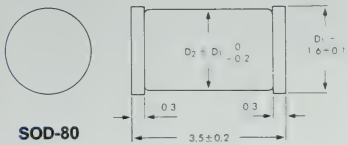
■ Philips Components offers surface mount temperature sensors having a measuring temperature range of −40 to +125°C, tolerances as low as 1%, and a wide range of center resistance. These sensors are extremely stable and more linear than NTC thermistors. Applications range from basic domestic temperature control to the most advanced industrial microprocessor-based control systems.

FEATURES

- Measuring temperature range −40 to +125°C
- Tolerances from 1% to 5%
- Excellent linearity over a wide temperature range
- SOD-80 for low cost, hermetic glass packaging

MECHANICAL DATA

(Dimensions in mm)



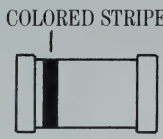
SOD-80

ELECTRICAL SPECIFICATIONS

TYPE	PACKAGE	TOLERANCE CLASS	MEASURING TEMP RANGE (°C)	RESISTANCE (TYP @25°C) (Ω)	THERMAL TIME CONSTANT		TEMPERATURE COEFFICIENT (%/°C)
					Still Air (sec)	Still Liquid (sec)	
KTY85-110	SOD-80	±1%	−25 to +125	1000	20	1	0.75
KTY85-120	SOD-80	±2%	−25 to +125	1000	20	1	0.75
KTY85-150	SOD-80	±5%	−25 to +125	1000	20	1	0.75

POLARITY AND MARKING CODES

Sensor must be operated with the lower potential at the end indicated by the colored stripe.

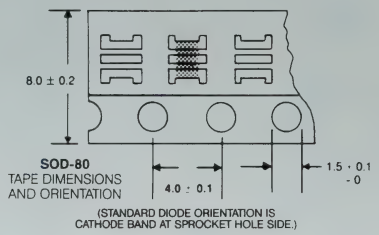


Type No.	Stripe Color
KTY85-110	Yellow
KTY85-120	White or Green
KTY85-150	Black or Blue

TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOD-80	2.5K	7	8	TRL
	10K	13	8	TRL 13



SMD TRIGGER DEVICES (PNPN)

DESCRIPTION

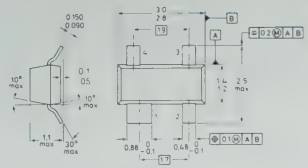
■ Philips Components trigger devices are planar P-N-P-N devices which can be used as programmable unijunction transistors (PUTs) or silicon controlled switches to switch relay and lamp drivers, sense temperature changes, and trigger thyristors and triacs. Applications include motor control, oscillators, timers, and pulse shapers.

FEATURES

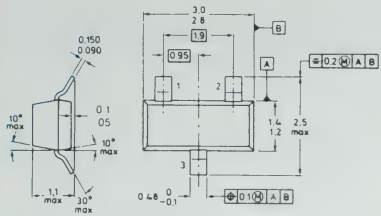
- 70V gate-anode voltage
- Continuous anode current up to 175 mA
- Surge currents as high as 3A
- Compatible with wave or reflow soldering

MECHANICAL DATA

(Dimensions in mm)



SOT-143 TOP VIEW

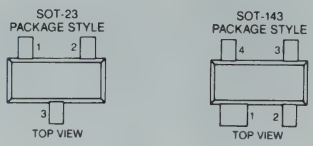


SOT-23 TOP VIEW

ELECTRICAL SPECIFICATIONS

TYPE	PACKAGE	V_{GA} max V	I_A max mA	I_D µA	I_V µA	PINOUT
BRY61	SOT-23	70	175	5/1	30/50	N
BRY62	SOT-143	70	175	–	–	P

PINOUT DIAGRAMS



	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT N: SOT-23	K	A	ANODE GATE	–
PINOUT P: SOT-143	ANODE GATE	A	K	CATHODE GATE

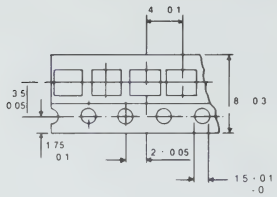
MARKING CODES

Type No.	Code
BRY61	A5
BRY62	A51

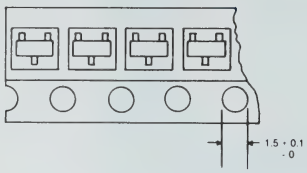
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

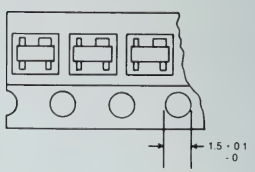
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13



SOT-23 and SOT-143
TAPE DIMENSIONS



SOT-23
ORIENTATION



SOT-143
ORIENTATION

SMD SWITCHING DIODES

DESCRIPTION

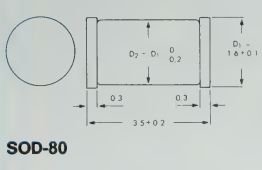
■ Philips Components diodes for switching applications combine the highest quality standards with state-of-the-art production equipment to fulfill the need for generic, low-cost devices. These switching diodes offer a broad range of current ratings, reverse breakdown voltages and switching specifications to address a variety of circuit requirements. They are offered in a choice of surface mount packages, providing the designer with alternatives for different power requirements, circuit board substrate materials, and assembly processing techniques.

FEATURES

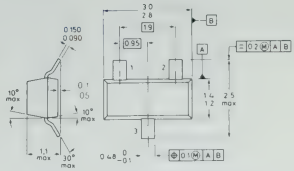
- Reverse breakdown voltages up to 200V
- Switching times as low as 2 ns
- Dual diodes in SOT-23 and SOT-143
- SOD-80 for low cost, hermetic glass packaging

MECHANICAL DATA

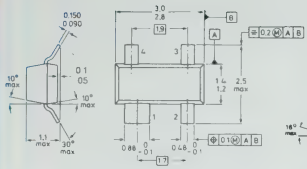
(Dimensions in mm)



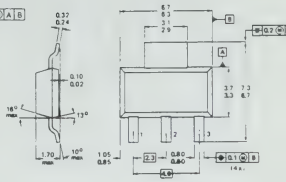
SOD-80



SOT-23 TOP VIEW



SOT-143 TOP VIEW



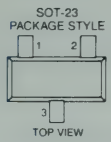
SOT-223

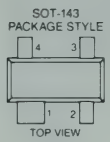
ELECTRICAL SPECIFICATIONS

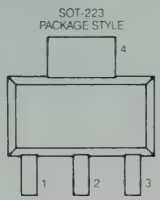
TYPE	PACKAGE	RATINGS		V_F		t_{rr}(max)	C_d(max)	PINOUT
		V_R V	I_F mA	mV	@I_F mA	ns	pF	
BAS16	SOT-23	75	250	1240	150	6	2	H
BAS19	SOT-23	100	200	1000	100	50	5	H
BAS20	SOT-23	150	200	1000	100	50	5	H
BAS21	SOT-23	200	200	1000	100	50	5	H
BAS28*	SOT-143	75	250	1000	100	50	5	J
BAS29	SOT-23	90	250	900	100	50	35	H
BAS31*	SOT-23	90	250	900	100	50	35	K
BAS32L	SOD-80	75	200	1000	100	4	2	–
BAS35*	SOT-23	90	100	900	100	50	35	L
BAS56*	SOT-143	60	200	1000	200	6	2.5	J
BAV23*	SOT-143	200	200	1000	100	50	5	J
BAV23S*	SOT-223	200	200	1000	100	50	5	K
BAV70*	SOT-23	70	250	1250	150	6	1.5	M
BAV74*	SOT-23	50	100	1000	100	4	2	M
BAV99*	SOT-23	70	250	1250	150	6	1.5	K
BAV100	SOD-80	50	250	1000	100	50	5	–
BAV101	SOD-80	100	250	1000	100	50	5	–
BAV102	SOD-80	150	250	1000	100	50	5	–
BAV103	SOD-80	200	250	1000	100	50	5	–
BAV105	SOD-80	60	600	1000	200	6	2	–
BAW56*	SOT-23	70	250	1250	150	6	2	L
PMBD914	SOT-23	100	200	1000	10	15	4	H
PMBD2835*	SOT-23	35	100	1200	100	15	4	L
PMBD2836*	SOT-23	75	100	1200	100	15	4	L
PMBD2837*	SOT-23	35	100	1200	100	15	4	M
PMBD2838*	SOT-23	75	100	1200	100	15	4	M
PMBD6050	SOT-23	70	200	1100	100	15	2.5	H
PMBD6100*	SOT-23	70	200	1100	100	15	2.5	M
PMBD7000*	SOT-23	100	200	1100	100	15	1.5	K
PMLL4148	SOD-80	75	200	1000	100	4	4	–
PMLL4150	SOD-80	50	300	920	100	4	2.5	–
PMLL4151	SOD-80	75	200	1000	50	2	2	–
PMLL4153	SOD-80	75	200	880	20	2	2	–
PMLL4446	SOD-80	75	200	1000	100	4	4	–
PMLL4448	SOD-80	75	200	1000	100	4	4	–

*Dual Diode

PINOUT DIAGRAMS







	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT H: SOT-23	N.C.	A	K	—
PINOUT J: SOT-143	K1	K2	A2	A1
PINOUT K: SOT-23	K1	A2	K_2,A_1	—
PINOUT K: SOT-223	K1	A2	K2,A1	N.C.
PINOUT L: SOT-23	K1	K2	A_1,A_2	—
PINOUT M: SOT-23	A1	A2	K_1,K_2	—

MARKING CODES

Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BAS16	A6	BAS31	L21	BAV74	JA	PMBD2837	A5
BAS19	JP	BAS35	L22	BAV99	A7	PMBD2838	A6
BAS20	JR	BAS56	L51	BAW56	A1	PMBD6050	5A
BAS21	JS	BAV23	L30	PMBD914	5D	PMBD6100	5B
BAS28	JT	BAV23S	L21	PMBD2835	A3	PMBD7000	5G
BAS29	L20	BAV70	A4	PMBD2836	A2		

For the following types in SOD-80 packaging, colored stripes identify the device type and also identify the cathode end of the diode:

Type No.	Stripe Color	Type No.	Stripe Color	Type No.	Stripe Color
BAS32L	*	BAV103	Green and Orange	PMLL4151	Black
BAV100	Green and Black	BAV105	Green	PMLL4153	Black
BAV101	Green and Brown	PMLL4148	Black	PMLL4446	Black
BAV102	Green and Red	PMLL4150	Black	PMLL4448	Black

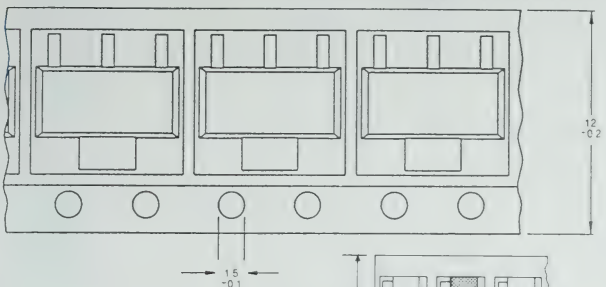
*See individual device data sheet.

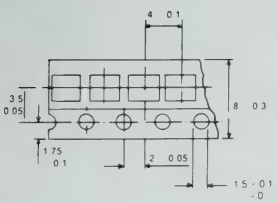
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

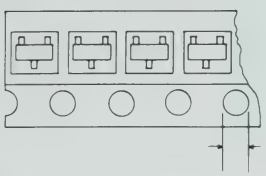
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-223	1K	7	12	TRL
	4K	13	12	TRL 13
SOD-80	2.5K	7	8	TRL
	10K	13	8	TRL 13

SOT-223 TAPE DIMENSIONS AND ORIENTATION

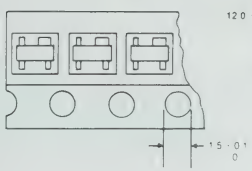




SOT-23 and SOT-143
TAPE DIMENSIONS



SOT-23
ORIENTATION



SOT-143
ORIENTATION

SOT-89
TAPE DIMENSIONS
AND ORIENTATION

(STANDARD DIODE ORIENTATION IS CATHODE BAND AND AT SPROCKET HOLE SIDE.)

SMD BANDSWITCH DIODES

DESCRIPTION

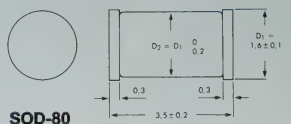
■ Philips Components bandswitch diodes are intended specifically for use in radio, television, and other tuning applications. Primary attributes are extremely low dynamic capacitance and series resistance.

FEATURES

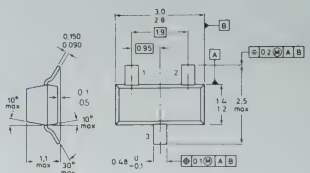
- Guaranteed maximum dynamic capacitance as low as 1.2 pF at 3V reverse voltage
- Guaranteed maximum dynamic resistances as low as 0.7Ω at 3 mA
- SOD-80 for low-cost, hermetic glass packaging

MECHANICAL DATA

(Dimensions in mm)



SOD-80

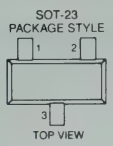


SOT-23 TOP VIEW

ELECTRICAL SPECIFICATIONS

TYPE	PACKAGE	RATINGS		C_d (max)		r_D (max)			PINOUT
		V_R V	I_F mA	pF	@V_R V	Ω	@I_F mA	@f MHz	
BA423L	SOD-80	20	50	3.5	6	1.5	10	1	–
BA682	SOD-80	35	100	1.25	3	0.7	3	200	–
BA683	SOD-80	35	100	1.20	3	1.2	3	200	–
BAT18	SOT-23	35	100	1.00	20	0.7	5	200	H

PINOUT DIAGRAMS



	PIN 1	PIN 2	PIN 3
PINOUT H: SOT-23	N.C.	A	K

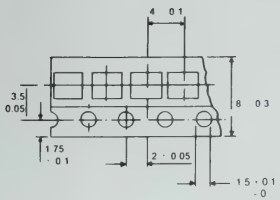
MARKING CODES

Type No.	Code or Stripe Color
BA423L	Green and Red Stripes
BA682	Red Stripe
BA683	Red and Orange Stripes
BAT18	A2

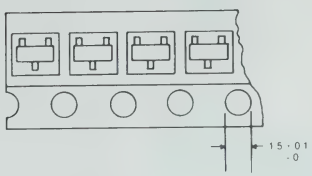
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

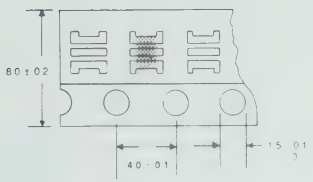
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOD-80	2.5K	7	8	TRL
	10K	13	8	TRL 13



SOT-23
TAPE DIMENSIONS



SOT-23
ORIENTATION



SOD-80
TAPE DIMENSIONS
AND ORIENTATION
(STANDARD DIODE ORIENTATION IS
CATHODE BAND AT SPROCKET HOLE SIDE)

VARIABLE CAPACITANCE SMD DIODES

DESCRIPTION

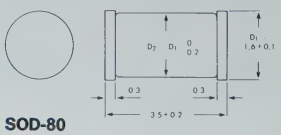
■ Philips Components variable capacitance (varicap) diodes are optimized to exhibit linear, highly dependable dynamic capacitance characteristics over the entire rated range of reverse voltage values. The devices also have very low series resistance and can be used in all AM, FM, VHF and UHF circuits where tuning is required. They are offered in a choice of surface mount packages, providing the designer with alternatives for different power requirements, circuit board substrate materials, and assembly processing techniques.

FEATURES

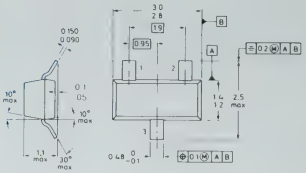
- Guaranteed minimum and maximum capacitance ratio over working voltage range
- Operating reverse voltage ranges from 0.5V to 28V
- Typical series resistance as low as 0.2Ω
- Dual diodes in SOT-23 and SOT-143
- SOD-80 for low-cost, hermetic glass packaging

MECHANICAL DATA

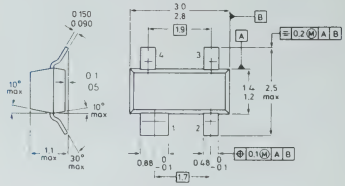
(Dimensions in mm)



SOD-80



SOT-23 TOP VIEW



SOT-143 TOP VIEW

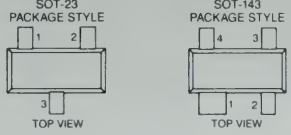
ELECTRICAL SPECIFICATIONS

TYPE	PACKAGE	RATINGS V_R V	RATINGS I_F mA	C_d at V_R pF	C_d at V_R V	C_d RATIO f=1 MHz min	C_d RATIO f=1 MHz typ.	C_d RATIO f=1 MHz max	C_d RATIO @V1/V2	r_s max Ω	PINOUT
BB215	SOD-80	30	20	18 min.	1	7.6	–	–	1/28	–	–
BB219	SOD-80	30	20	31 min.	1	12	–	–	1/28	–	–
BB804	SOT-23	18	50	44.5 typ.	2	1.65	–	1.75	2/8	0.2	L
BBY31	SOT-23	28	20	1.8-2.8	25	–	5	–	3/25	1.2	H
BBY39*	SOT-23	30	20	1.8-2.0	28	7.6	–	–	1/28	0.8	M
BBY40	SOT-23	28	20	4.3-6	25	5	–	5.6	3/25	0.6	H
BBY42	SOT-23	32	50	31 min.	1	12	–	16	1/28	1.2	H
BBY62*	SOT-143	30	50	17.5 typ.	1	–	5	–	3/25	1.0	J

*Dual diode

PINOUT DIAGRAMS

	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT H: SOT-23	N.C.	A	K	–
PINOUT J: SOT-143	K_1	K_2	A_2	A_1
PINOUT L: SOT-23	K_1	K_2	K_1K_2	–
PINOUT M: SOT-23	A_1	A_2	K_1K_2	–



MARKING CODES

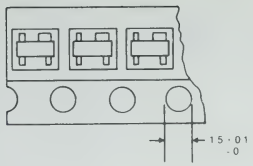
Type No.	Code or Stripe Color	Type No.	Code or Stripe Color	Type No.	Code or Stripe Color
BB215	Green and White	BBY31	S1	BBY42	*
BB219	White	BBY39	*	BBY62	S4
BB804	S3	BBY40	S2		

*See individual device data sheet

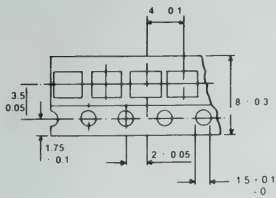
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

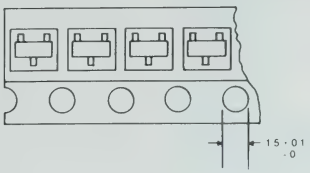
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOD-80	2.5K	7	8	TRL
	10K	13	8	TRL 13



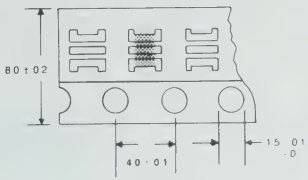
SOT-143
ORIENTATION



SOT-23
TAPE DIMENSIONS



SOT-23
ORIENTATION



SOD-80
TAPE DIMENSIONS
AND ORIENTATION
(STANDARD DIODE ORIENTATION IS
CATHODE BAND AT SPROCKET HOLE SIDE)

SMD SCHOTTKY DIODES

DESCRIPTION

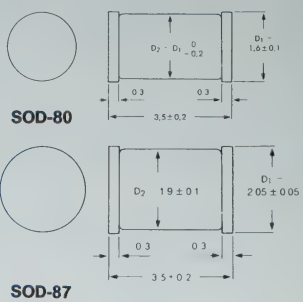
■ Philips Components Schottky barrier diodes are metal junction devices which combine the attributes of low forward voltage drop with fast switching times. Specific applications include battery back-up circuits, overshoot/undershoot protection, and voltage reference. They are offered in a choice of surface mount packages, providing the designer with alternatives for different power requirements, circuit board substrate materials, and assembly processing techniques.

FEATURES

- V_F as low as 400 mV at 10 mA
- Switching times under 1 ns
- Continuous current ratings up to 1A
- Dual diodes in SOT-23 and SOT-143
- SOD-80 for low-cost, hermetic glass packaging

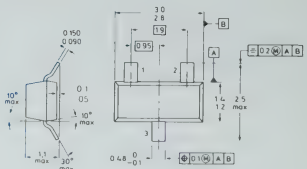
MECHANICAL DATA

(Dimensions in mm)

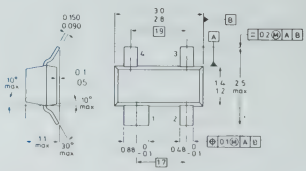


SOD-80

SOD-87



SOT-23 TOP VIEW



SOT-143 TOP VIEW

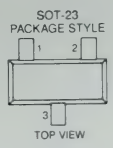
ELECTRICAL SPECIFICATIONS

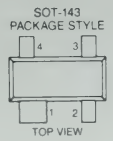
TYPE	PACKAGE	RATINGS		C_d (max)		V_F		I_R		PINOUT
		V_R V	I_F mA	pF	@V_R V	mV	@I_F mA	MAX μA	@V_R V	
PMBD101	SOT-23	4	10	1	0	600	10	0.25	3	H
PMBD352*	SOT-23	4	10	1	0	600	10	0.25	3	K
PMBD353*	SOT-23	4	10	1	0	600	10	0.25	3	U
BAT17	SOT-23	4	30	1	0	600	10	0.25	3	H
PRLL5817	SOD-87	20	1000	70	4	450	1000	1000	20	–
PRLL5818	SOD-87	30	1000	50	4	550	1000	500	30	–
PRLL5819	SOD-87	40	1000	50	4	600	1000	500	40	–
BAS85	SOD-80	30	200	10	1	400	10	2.0	25	–
BAT54	SOT-23	30	200	10	1	400	10	2.0	25	H
BAT74*	SOT-143	30	200	10	1	400	10	2.0	25	J
BAT54A*	SOT-23	30	200	10	1	400	10	2.0	25	L
BAT54C*	SOT-23	30	200	10	1	400	10	2.0	25	M
BAT54S*	SOT-23	30	200	10	1	400	10	2.0	25	K
BAS86	SOD-80	50	200	8	1	600	10	5.0	40	–

*Dual Diode

PINOUT DIAGRAMS

	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT H: SOT-23	N.C.	A	K	–
PINOUT J: SOT-143	K_1	K_2	A_2	A_1
PINOUT K: SOT-23	K_1	A_2	K_2,A_1	–
PINOUT L: SOT-23	K_1	K_2	A_1,A_2	–
PINOUT M: SOT-23	A_1	A_2	K_1,K_2	–
PINOUT U: SOT-23	A_1	K_2	K_1,A_2	–





MARKING CODES

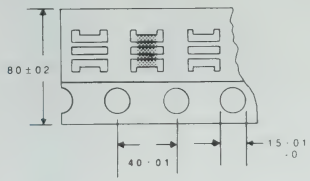
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BAS85	*	BAT54A	*	PMBD101	4M	PRLL5818	*
BAS86	*	BAT54C	*	PMBD352	5G	PRLL5819	*
BAT17	A3	BAT54S	*	PMBD353	4F		
BAT54	L4	BAT74	JA	PRLL5817	*		

*See individual device data sheet.

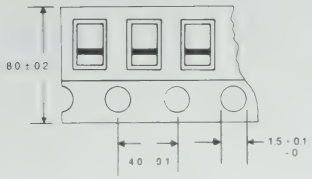
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOT-143	3K	7	8	TRL
	10K	13	8	TRL 13
SOD-80	2.5K	7	8	TRL
	10K	13	8	TRL 13
SOD-87	2K	7	8	TRL

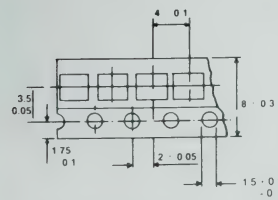


SOD-80
TAPE DIMENSIONS
AND ORIENTATION

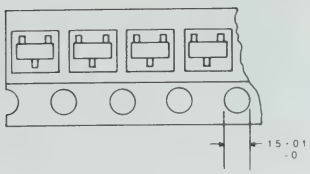


SOD-87
TAPE DIMENSIONS
AND ORIENTATION

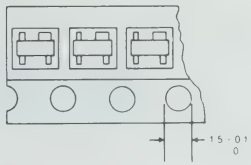
(STANDARD DIODE ORIENTATION IS
CATHODE BAND AT SPROCKET HOLE SIDE)



SOT-23 and SOT-143
TAPE DIMENSIONS



SOT-23
ORIENTATION



SOT-143
ORIENTATION

SMD RECTIFIERS

DESCRIPTION

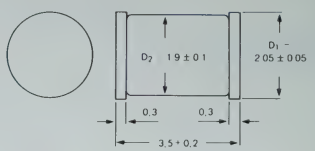
■ Philips Components 1 Amp rectifier diodes in the SOD-87 hermetic glass MELF package are encapsulated using a state-of-the-art implosion technology. The SOD-87 package is created by heating the chip, studs, and glass sleeve in a vacuum chamber, then collapsing the vacuum and allowing implosion of the glass sleeve. The result is a high-quality, void-free, low resistance pressure contact between the metal stud leads and the rectifier chip.

FEATURES

- Low cost general purpose devices
- Versatile high-speed devices guaranteed for 250 ns switching times
- Ultrafast device specified for switching speeds under 25 ns
- Unique 3.5 mm package length allows board space savings

MECHANICAL DATA

(Dimensions in mm)



SOD-87

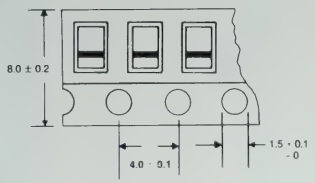
ELECTRICAL SPECIFICATIONS

TYPE	PACKAGE	$I_{F(AV)}$(MAX) (A)	V_{RRM} (V)	I_{FSM} (A)	V_F(MAX) (V)	@I_F (A)	t_{rr} (MAX) (ns)
GENERAL PURPOSE							
BYD17D	SOD-87	1.5	200	20	1.05	1	–
BYD17G	SOD-87	1.5	400	20	1.05	1	–
BYD17J	SOD-87	1.5	600	20	1.05	1	–
BYD17K	SOD-87	1.5	800	20	1.05	1	–
BYD17M	SOD-87	1.5	1000	20	1.05	1	–
PRLL4001	SOD-87	1.5	50	20	.08	1	–
PRLL4002	SOD-87	1.5	100	20	.08	1	–
FAST RECOVERY							
BYD37D	SOD-87	1.5	200	20	1.3	1	250
BYD37G	SOD-87	1.5	400	20	1.3	1	250
BYD37J	SOD-87	1.5	600	20	1.3	1	250
BYD37K	SOD-87	1.5	800	20	1.3	1	300
BYD37M	SOD-87	1.5	1000	20	1.3	1	300
VERY FAST RECOVERY							
BYD77A	SOD-87	2	50	25	0.95	1	25
BYD77B	SOD-87	2	100	25	0.95	1	25
BYD77C	SOD-87	2	150	25	0.95	1	25
BYD77D	SOD-87	2	200	25	0.95	1	25
BYD77E	SOD-87	1.85	250	25	1.05	1	50
BYD77F	SOD-87	1.85	300	25	1.05	1	50
BYD77G	SOD-87	1.85	400	25	1.05	1	50

TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOD-87	2K	7	8	TRL



SOD-87
TAPE DIMENSIONS
AND ORIENTATION
(STANDARD DIODE ORIENTATION IS
CATHODE BAND AT SPROCKET HOLE SIDE)

VOLTAGE REFERENCE SMD DIODES

DESCRIPTION

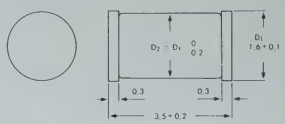
■ Philips Components voltage reference series is composed of stabistors (low voltage stabilizing diodes) and temperature compensating 6.2V reference diodes. Primary applications are for voltage bias stabilization and signal clipping and clamping.

FEATURES

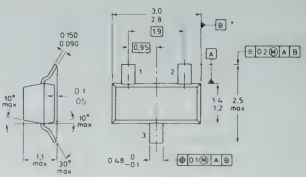
- Guaranteed temperature coefficients less than 0.005%/°C
- Differential resistance less than 6Ω @ 10 mA
- Compatible with wave or reflow soldering
- SOD-80 for low-cost, hermetic glass packaging

MECHANICAL DATA

(Dimensions in mm)



SOD-80



SOT-23 TOP VIEW

ELECTRICAL SPECIFICATIONS

TYPE	PACKAGE	DESCRIPTION	REFERENCE VOLTAGE		TEMPERATURE COEFFICIENT	PINOUT
			V	@ mA		
BA314L	SOD-80	Stabistor	0.85-0.94	100	-1.8mV/°C	—
BAS17	SOT-23	Stabistor	0.87-0.96	100	-1.8mV/°C	H
BZV80	SOD-80	6.2V Reference	5.89-6.51	7.5	0.01%/°C	—
BZV81	SOD-80	6.2V Reference	5.89-6.51	7.5	0.005%/°C	—

PINOUT DIAGRAMS

	PIN 1	PIN 2	PIN 3	PIN 4
PINOUT H: SOT–23	N.C.	A	K	—

MARKING CODES

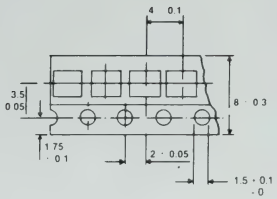
Type No.	Code or Stripe Color
BA314L	*
BAS17	A91
BZV80	Yellow and Black Stripes
BZV81	Yellow and Brown Stripes

*See individual device data sheet.

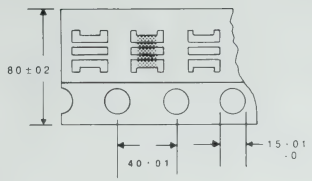
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOD-80	2.5K	7	8	TRL
	10K	13	8	TRL 13



SOT-23
TAPE DIMENSIONS



SOD-80
TAPE DIMENSIONS
AND ORIENTATION
(STANDARD DIODE ORIENTATION IS
CATHODE BAND AT SPROCKET HOLE SIDE)

SMD ZENER DIODES

DESCRIPTION

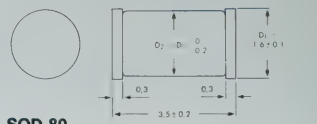
■ Philips Components Zener diodes combine the highest quality standards with state-of-the-art production equipment to fulfill the need for generic, low-cost devices. This family offers a broad range of nominal voltage values, test current limits, and dynamic resistance specifications to address the multitude of circuit requirements. They are offered in a choice of surface mount packages, providing the designer with alternatives for different power requirements, circuit board substrate materials and assembly processing techniques.

FEATURES

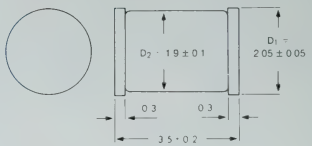
- Nominal voltage ranges from 2.4V to 510V
- Zener voltage tolerances from 1% to 5%
- SOD-87 for up to 2.3W power dissipation rating
- SOD-80 for low-cost, hermetic glass packaging

MECHANICAL DATA

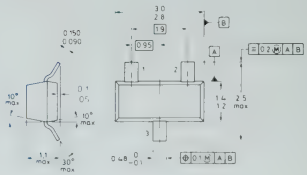
(Dimensions in mm)



SOD-80



SOD-87



SOT-23 TOP VIEW

ELECTRICAL SPECIFICATIONS, 500mW, SOD-80 PACKAGE

TYPE	V_Z (NOM)*		ZENER IMPEDANCE			TEMPERATURE COEFFICIENT	I_R (MAX)	
			Z_{zt} (MAX)		Z_{zk}(MAX)			
	(V)	@I_Z (mA)	Ω	@i_{ZT} (mA)	@I_{ZK} = 0.25mA (Ω)	Θ_{VZ} (MAX) (%/°C)	(μA)	@V_R (V)
PMLL5225B	3.0	20	29	20	1600	-0.075	50	1.0
PMLL5226B	3.3	20	28	20	1600	-0.070	25	1.0
PMLL5227B	3.6	20	24	20	1700	-0.065	15	1.0
PMLL5228B	3.9	20	23	20	1900	-0.060	10	1.0
PMLL5229B	4.3	20	22	20	2000	±0.055	5.0	1.0
PMLL5230B	4.7	20	19	20	1900	±0.030	5.0	2.0
PMLL5231B	5.1	20	17	20	1600	±0.030	5.0	2.0
PMLL5232B	5.6	20	11	20	1600	+0.038	5.0	3.0
PMLL5233B	6.0	20	7	20	1600	+0.038	5.0	3.5
PMLL5234B	6.2	20	7	20	1000	+0.045	5.0	4.0
PMLL5235B	6.8	20	5	20	750	+0.050	3.0	5.0
PMLL5236B	7.5	20	6	20	500	+0.058	3.0	6.0
PMLL5237B	8.2	20	8	20	500	+0.062	3.0	6.5
PMLL5238B	8.7	20	8	20	600	+0.065	3.0	6.5
PMLL5239B	9.1	20	10	20	600	+0.068	3.0	7.0
PMLL5240B	10	20	17	20	600	+0.075	3.0	8.0
PMLL5241B	11	20	22	20	600	+0.076	2.0	8.4
PMLL5242B	12	20	30	20	600	+0.077	1.0	9.1
PMLL5243B	13	9.5	13	9.5	600	+0.079	0.5	9.9
PMLL5244B	14	9.0	15	9.0	600	+0.082	0.1	10
PMLL5245B	15	8.5	16	8.5	600	+0.082	0.1	11
PMLL5246B	16	7.8	17	7.8	600	+0.083	0.1	12
PMLL5247B	17	7.4	19	7.4	600	+0.084	0.1	13
PMLL5248B	18	7.0	21	7.0	600	+0.085	0.1	14
PMLL5249B	19	6.6	23	6.6	600	+0.086	0.1	14
PMLL5250B	20	6.2	25	6.2	600	+0.086	0.1	15
PMLL5251B	22	5.6	29	5.6	600	+0.087	0.1	17
PMLL5252B	24	5.2	33	5.2	600	+0.088	0.1	18
PMLL5253B	25	5.0	35	5.0	600	+0.089	0.1	19
PMLL5254B	27	4.6	41	4.6	600	+0.090	0.1	21
PMLL5255B	28	4.5	44	4.5	600	+0.091	0.1	21
PMLL5256B	30	4.2	49	4.2	600	+0.091	0.1	23
PMLL5257B	33	3.8	58	3.8	700	+0.092	0.1	25
PMLL5258B	36	3.4	70	3.4	700	+0.093	0.1	27
PMLL5259B	39	3.2	80	3.2	800	+0.094	0.1	30
PMLL5260B	43	3.0	93	3.2	900	+0.095	0.1	33
PMLL5261B	47	2.7	105	2.7	1000	+0.095	0.1	36
PMLL5262B	51	2.5	125	2.5	1100	+0.096	0.1	39
PMLL5263B	56	2.2	150	2.2	1300	+0.096	0.1	43
PMLL5264B	60	2.1	170	2.1	1400	+0.097	0.1	46
PMLL5265B	62	2.0	185	2.0	1400	+0.097	0.1	47
PMLL5266B	68	1.8	230	1.8	1600	+0.097	0.1	52
PMLL5267B	75	1.7	270	1.7	1700	+0.098	0.1	56

*Tolerance = ±5%

...continued

ELECTRICAL SPECIFICATIONS, 500 mW, SOD-80 PACKAGE (Continued)

TYPE	ZENER VOLTAGE* V_Z at I_Z			MAXIMUM DIFFERENTIAL RESISTANCE t_{diff} at I_Z		MAXIMUM TEMPERATURE COEFFICIENT S_Z at I_Z		MAXIMUM REVERSE CURRENT I_R at V_R	
	V		mA						
	MIN	MAX		Ω	mA	mV/°C	mA	μA	V
BZV55C2V4	2.2	2.6	5	100	5	-3.5	5	50	1
BZV55C2V7	2.5	2.9	5	100	5	-3.5	5	20	1
BZV55C3V0	2.8	3.2	5	95	5	-3.5	5	10	1
BZV55C3V3	3.1	3.5	5	95	5	-3.5	5	5	1
BZV55C3V6	3.4	3.8	5	90	5	-3.5	5	5	1
BZV55C3V9	3.7	4.1	5	90	5	-3.5	5	3	1
BZV55C4V3	4.0	4.6	5	90	5	-3.5	5	3	1
BZV55C4V7	4.4	5.0	5	80	5	-3.5	5	3	2
BZV55C5V1	4.8	5.4	5	60	5	-2.7	5	2	2
BZV55C5V6	5.2	6.0	5	40	5	2.5	5	1	2
BZV55C6V2	5.8	6.6	5	10	5	3.7	5	3	4
BZV55C6V8	6.4	7.2	5	15	5	4.5	5	2	4
BZV55C7V5	7.0	7.9	5	15	5	5.3	5	1	5
BZV55C8V2	7.7	8.7	5	15	5	6.2	5	.700	5
BZV55C9V1	8.5	9.6	5	15	5	7.0	5	.500	6
BZV55C10	9.4	10.6	5	20	5	8.0	5	.200	7
BZV55C11	10.4	11.6	5	20	5	9.0	5	.100	8
BZV55C12	11.4	12.7	5	25	5	10.0	5	.100	8
BZV55C13	12.4	14.1	5	30	5	11.0	5	.100	8
BZV55C15	13.8	15.6	5	30	5	13.0	5	.050	0.7 V_Z nom
BZV55C16	15.3	17.1	5	40	5	14.0	5	.050	0.7 V_Z nom
BZV55C18	16.8	19.1	5	45	5	16.0	5	.050	0.7 V_Z nom
BZV55C20	18.8	21.2	5	55	5	18.0	5	.050	0.7 V_Z nom
BZV55C22	20.8	23.3	5	55	5	20.0	5	.050	0.7 V_Z nom
BZV55C24	22.8	25.6	5	70	5	22.0	5	.050	0.7 V_Z nom
BZV55C27	25.1	28.9	2	80	2	25.3	2	.050	0.7 V_Z nom
BZV55C30	28.0	32.0	2	80	2	29.4	2	.050	0.7 V_Z nom
BZV55C33	31.0	35.0	2	80	2	33.4	2	.050	0.7 V_Z nom
BZV55C36	34.0	38.0	2	90	2	37.4	2	.050	0.7 V_Z nom
BZV55C39	37.0	41.0	2	130	2	41.2	2	.050	0.7 V_Z nom
BZV55C43	40.0	46.0	2	150	2	46.6	2	.050	0.7 V_Z nom
BZV55C47	44.0	50.0	2	170	2	51.8	2	.050	0.7 V_Z nom
BZV55C51	48.0	54.0	2	180	2	57.2	2	.050	0.7 V_Z nom
BZV55C56	52.0	60.0	2	200	2	63.8	2	.050	0.7 V_Z nom
BZV55C62	58.0	66.0	2	215	2	71.6	2	.050	0.7 V_Z nom
BZV55C68	64.0	72.0	2	240	2	79.8	2	.050	0.7 V_Z nom
BZV55C75	70.0	79.0	2	255	2	88.6	2	.050	0.7 V_Z nom

*E24 Logarithmic Range (tolerance 5%)

Note: Also available in E24: 3% tolerance, reference BZV55F series
2% tolerance, reference BZV55B series
1% tolerance, reference BZV55A series

ELECTRICAL SPECIFICATIONS, 2.3W, SOD-87 PACKAGE

TYPE	ZENER VOLTAGE V_Z at I_Z (V) MIN	(V) MAX	(mA)	MAXIMUM DIFFERENTIAL RESISTANCE r_{diff} at I_Z (Ω)	(mA)	MAXIMUM TEMPERATURE COEFFICIENT S_Z at I_Z (%/°C)	(mA)	MAXIMUM REVERSE CURRENT I_R at V_R (μ)	(V)
BZD27C7V5	7.0	7.9	100	2	100	0.07	100	50	3
BZD27C8V2	7.7	8.7	100	2	100	0.08	100	10	3
BZD27C9V1	8.5	9.6	50	4	50	0.08	50	5	5
BZD27C10	9.4	10.6	50	4	50	0.09	50	7	7.5
BZD27C11	10.4	11.6	50	7	50	0.10	50	3	8.2
BZD27C12	11.4	12.7	50	7	50	0.10	50	2	9.1
BZD27C13	12.4	14.1	50	10	50	0.10	50	2	10
BZD27C15	13.8	15.6	50	10	50	0.10	50	1	11
BZD27C16	15.3	17.1	25	15	25	0.11	25	1	12
BZD27C18	16.8	19.1	25	15	25	0.11	25	1	13
BZD27C20	18.8	21.2	25	15	25	0.11	25	1	15
BZD27C22	20.8	23.3	25	15	25	0.11	25	1	16
BZD27C24	22.8	25.6	25	15	25	0.11	25	1	18
BZD27C27	25.1	28.9	25	15	25	0.11	25	1	20
BZD27C30	28	32	25	15	25	0.11	25	1	22
BZD27C33	31	35	25	15	25	0.11	25	1	24
BZD27C36	34	38	10	40	10	0.11	10	1	27
BZD27C39	37	41	10	40	10	0.11	10	1	30
BZD27C43	40	46	10	45	10	0.12	10	1	33
BZD27C47	44	50	10	45	10	0.12	10	1	36
BZD27C51	48	54	10	60	10	0.12	10	1	39
BZD27C56	52	60	10	60	10	0.12	10	1	43
BZD27C62	58	66	10	80	10	0.13	10	1	47
BZD27C68	64	72	10	80	10	0.13	10	1	51
BZD27C75	70	79	10	100	10	0.13	10	1	56
BZD27C82	77	87	10	100	10	0.13	10	1	62
BZD27C91	85	96	5	200	5	0.13	5	1	68
BZD27C100	94	106	5	200	5	0.13	5	1	75
BZD27C110	104	116	5	250	5	0.13	5	1	82
BZD27C120	114	127	5	250	5	0.13	5	1	91
BZD27C130	124	141	5	300	5	0.13	5	1	100
BZD27C150	138	156	5	300	5	0.13	5	1	110
BZD27C160	153	171	5	350	5	0.13	5	1	120
BZD27C180	168	191	5	400	5	0.13	5	1	130
BZD27C200	188	212	5	500	5	0.13	5	1	150
BZD27C220	208	233	2	750	2	0.13	2	1	160
BZD27C240	228	256	2	850	2	0.13	2	1	180
BZD27C270	251	289	2	1000	2	0.13	2	1	200

ELECTRICAL SPECIFICATIONS, 350MW, SOT-23 PACKAGE

TYPE	ZENER VOLTAGE* V_Z at I_Z (V)			MAXIMUM DIFFERENTIAL RESISTANCE r_{diff} at I_Z		MAXIMUM TEMPERATURE COEFFICIENT S_Z at I_Z		MAXIMUM REVERSE CURRENT I_R at V_R		PINOUT
	MIN	MAX	(mA)	(Ω)	(mA)	(mV/°C)	(mA)	(μA)	(V)	
BZX84C2V4	2.2	2.6	5	100	5	−3.5	5	50	1	H
BZX84C2V7	2.5	2.9	5	100	5	−3.5	5	20	1	H
BZX84C3V0	2.8	3.2	5	95	5	−3.5	5	10	1	H
BZX84C3V3	3.1	3.5	5	95	5	−3.5	5	5	1	H
BZX84C3V6	3.4	3.8	5	90	5	−3.5	5	5	1	H
BZX84C3V9	3.7	4.1	5	90	5	−3.5	5	3	1	H
BZX84C4V3	4.0	4.6	5	90	5	−3.5	5	3	1	H
BZX84C4V7	4.4	5.0	5	80	5	−3.5	5	3	2	H
BZX84C5V1	4.8	5.4	5	60	5	−2.7	5	2	2	H
BZX84C5V6	5.2	6.0	5	40	5	2.5	5	1	2	H
BZX84C6V2	5.8	6.6	5	10	5	3.7	5	3	4	H
BZX84C6V8	6.4	7.2	5	15	5	4.5	5	2	4	H
BZX84C7V5	7.0	7.9	5	15	5	5.3	5	1	5	H
BZX84C8V2	7.7	8.7	5	15	5	6.2	5	.700	5	H
BZX84C9V1	8.5	9.6	5	15	5	7.0	5	.500	6	H
BZX84C10	9.4	10.6	5	20	5	8.0	5	.200	7	H
BZX84C11	10.4	11.6	5	20	5	9.0	5	.100	8	H
BZX84C12	11.4	12.7	5	25	5	10.0	5	.100	8	H
BZX84C13	12.4	14.1	5	30	5	11.0	5	.100	8	H
BZX84C15	13.8	15.6	5	30	5	13.0	5	.050	0.7 V_Z nom	H
BZX84C16	15.3	17.1	5	40	5	14.0	5	.050	0.7 V_Z nom	H
BZX84C18	16.8	19.1	5	45	5	16.0	5	.050	0.7 V_Z nom	H
BZX84C20	18.8	21.2	5	55	5	18.0	5	.050	0.7 V_Z nom	H
BZX84C22	20.8	23.3	5	55	5	20.0	5	.050	0.7 V_Z nom	H
BZX84C24	22.8	25.6	5	70	5	22.0	5	.050	0.7 V_Z nom	H
BZX84C27	25.1	28.9	2	80	2	25.3	2	.050	0.7 V_Z nom	H
BZX84C30	28.0	32.0	2	80	2	29.4	2	.050	0.7 V_Z nom	H
BZX84C33	31.0	35.0	2	80	2	33.4	2	.050	0.7 V_Z nom	H
BZX84C36	34.0	38.0	2	90	2	37.4	2	.050	0.7 V_Z nom	H
BZX84C39	37.0	41.0	2	130	2	41.2	2	.050	0.7 V_Z nom	H
BZX84C43	40.0	46.0	2	150	2	46.6	2	.050	0.7 V_Z nom	H
BZX84C47	44.0	50.0	2	170	2	51.8	2	.050	0.7 V_Z nom	H
BZX84C51	48.0	54.0	2	180	2	57.2	2	.050	0.7 V_Z nom	H
BZX84C56	52.0	60.0	2	200	2	63.8	2	.050	0.7 V_Z nom	H
BZX84C62	58.0	66.0	2	215	2	71.6	2	.050	0.7 V_Z nom	H
BZX84C68	64.0	72.0	2	240	2	79.8	2	.050	0.7 V_Z nom	H
BZX84C75	70.0	79.0	2	255	2	88.6	2	.050	0.7 V_Z nom	H

...continued

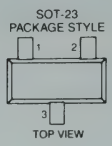
*E24 Logarithmic range (tolerance 5%)
Note: also available in E24: 3% tolerance, reference BZX84F Series.
2% tolerance, reference BZX84B Series.
1% tolerance, reference BZX84A Series.

ELECTRICAL SPECIFICATIONS, 350MW, SOT-23 PACKAGE (continued)

TYPE	V_Z (NOM)*		ZENER IMPEDANCE			TEMPERATURE COEFFICIENT	I_R (MAX)		PINOUT
			Z_{zt} (MAX)		Z_{zk} (MAX) @I_{ZK}=0.25mA				
	(V)	@I_Z (mA)	Ω	@I_{ZT} (mA)	(Ω)	Θ_{VZ} (MAX) (%/°C)	(μA)	@V_R (V)	
PMBZ5226B	3.3	20	28	20	1600	−0.070	25	1.0	H
PMBZ5227B	3.6	20	24	20	1700	−0.065	15	1.0	H
PMBZ5228B	3.9	20	23	20	1900	−0.060	10	1.0	H
PMBZ5229B	4.3	20	22	20	2000	±0.055	5.0	1.0	H
PMBZ5230B	4.7	20	19	20	1900	±0.030	5.0	2.0	H
PMBZ5231B	5.1	20	17	20	1600	±0.030	5.0	2.0	H
PMBZ5232B	5.6	20	11	20	1600	+0.038	5.0	3.0	H
PMBZ5233B	6.0	20	7	20	1600	+0.038	5.0	3.5	H
PMBZ5234B	6.2	20	7	20	1000	+0.045	5.0	4.0	H
PMBZ5235B	6.8	20	5	20	750	+0.050	3.0	5.0	H
PMBZ5236B	7.5	20	6	20	500	+0.058	3.0	6.0	H
PMBZ5237B	8.2	20	8	20	500	+0.062	3.0	6.5	H
PMBZ5238B	8.7	20	8	20	600	+0.065	3.0	6.5	H
PMBZ5239B	9.1	20	10	20	600	+0.068	3.0	7.0	H
PMBZ5240B	10	20	17	20	600	+0.075	3.0	8.0	H
PMBZ5241B	11	20	22	20	600	+0.076	2.0	8.4	H
PMBZ5242B	12	20	30	20	600	+0.077	1.0	9.1	H
PMBZ5243B	13	9.5	13	9.5	600	+0.079	0.5	9.9	H
PMBZ5244B	14	9.0	15	9.0	600	+0.082	0.1	10	H
PMBZ5245B	15	8.5	16	8.5	600	+0.082	0.1	11	H
PMBZ5246B	16	7.8	17	7.8	600	+0.083	0.1	12	H
PMBZ5247B	17	7.4	19	7.4	600	+0.084	0.1	13	H
PMBZ5248B	18	7.0	21	7.0	600	+0.085	0.1	14	H
PMBZ5249B	19	6.6	23	6.6	600	+0.086	0.1	14	H
PMBZ5250B	20	6.2	25	6.2	600	+0.086	0.1	15	H
PMBZ5251B	22	5.6	29	5.6	600	+0.087	0.1	17	H
PMBZ5252B	24	5.2	33	5.2	600	+0.088	0.1	18	H
PMBZ5253B	25	5.0	35	5.0	600	+0.089	0.1	19	H
PMBZ5254B	27	4.6	31	4.6	600	+0.090	0.1	21	H
PMBZ5255B	28	4.5	44	4.5	600	+0.091	0.1	21	H
PMBZ5256B	30	4.2	49	4.2	600	+0.091	0.1	23	H
PMBZ5257B	33	3.8	58	3.8	700	+0.092	0.1	25	H

PINOUT DIAGRAMS

	PIN 1	PIN 2	PIN 3
PINOUT H: SOT-23	N.C.	A	K



MARKING CODES

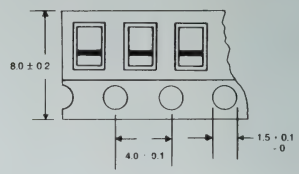
Type No.	Code	Type No.	Code	Type No.	Code	Type No.	Code
BZD27 Series	*	BZX84C12	Y2	BZX84C68	Y20	PMBZ5242B	8S
BZV55 Series	*	BZX84C13	Y3	BZX84C75	Y21	PMBZ5243B	8T
BZX84C2V4	Z11	BZX84C15	Y4	PMBZ5226B	8A	PMBZ5244B	8U
BZX84C2V7	Z12	BZX84C16	Y5	PMBZ5227B	8B	PMBZ5245B	8V
BZX84C3V0	Z13	BZX84C18	Y6	PMBZ5228B	8C	PMBZ5246B	8W
BZX84C3V3	Z14	BZX84C20	Y7	PMBZ5229B	8D	PMBZ5247B	8X
BZX84C3V6	Z15	BZX84C22	Y8	PMBZ5230B	8E	PMBZ5248B	8Y
BZX84C3V9	Z16	BZX84C24	Y9	PMBZ5231B	8F	PMBZ5249B	8Z
BZX84C4V3	Z17	BZX84C27	Y10	PMBZ5232B	8G	PMBZ5250B	81A
BZX84C4V7	Z1	BZX84C30	Y11	PMBZ5233B	8H	PMBZ5251B	81B
BZX84C5V1	Z2	BZX84C33	Y12	PMBZ5234B	8J	PMBZ5252B	81C
BZX84C5V6	Z3	BZX84C36	Y13	PMBZ5235B	8K	PMBZ5253B	81D
BZX84C6V2	Z4	BZX84C39	Y14	PMBZ5236B	8L	PMBZ5254B	81E
BZX84C6V8	Z5	BZX84C43	Y15	PMBZ5237B	8M	PMBZ5255B	81F
BZX84C7V5	Z6	BZX84C47	Y16	PMBZ5238B	8N	PMBZ5256B	81G
BZX84C8V2	Z7	BZX84C51	Y17	PMBZ5239B	8P	PMBZ5257B	81H
BZX84C9V1	Z8	BZX84C56	Y18	PMBZ5240B	8Q		
BZX84C10	Z9	BZX84C62	Y19	PMBZ5241B	8R		
BZX84C11	Y1						

*See individual device data sheet.

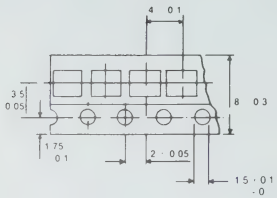
TAPE AND REEL SPECIFICATIONS

(Dimensions in mm)

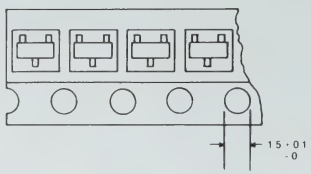
SM Package	Devices per reel	Reel Size (in)	Tape Width (mm)	Ordering Suffix
SOT-23	3K	7	8	TRL
	10K	13	8	TRL 13
SOD-80	2.5K	7	8	TRL
	10K	13	8	TRL 13
SOD-87	2K	7	8	TRL



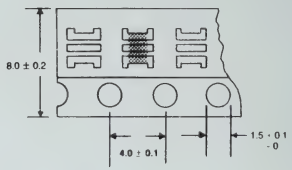
SOD-87
TAPE DIMENSIONS
AND ORIENTATION
(STANDARD DIODE ORIENTATION IS
CATHODE BAND AT SPROCKET HOLE SIDE)



SOT-23
TAPE DIMENSIONS



SOT-23
ORIENTATION



SOD-80
TAPE DIMENSIONS
AND ORIENTATION

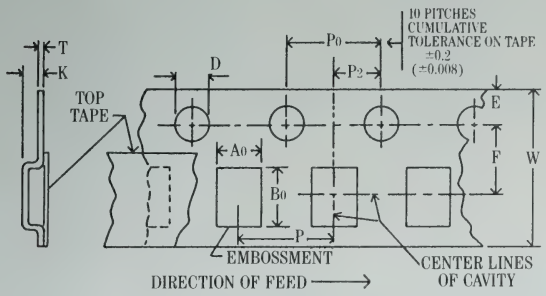
CHIP CAPACITOR AND CHIP RESISTOR PACKAGING

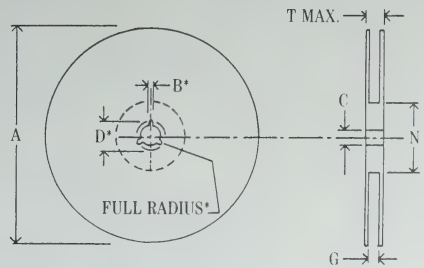
BULK

■ Philips Components standard bulk packaging is with a heat-sealed plastic bag. Quantities per container range from 500 to 10,000 pieces depending on chip size. A tarnish inhibitor is included in each container to protect terminations.

TAPE AND REEL

■ Specifically designed for high speed production, Philips Components offers a variety of chip sizes in a tape and reel package per EIA RS481 specifications. Flexacon, our own in-house manufactured embossed carrier tape is produced in 8mm and 12mm widths specifically for Philips Components chip capacitors and resistors. Both are available on 7 inch (2,500-4,000 pieces) or labor-saving 13 inch reels (10,000 pieces).





FLEXACON EMBOSSED CARRIER DIMENSIONS $\frac{\text{IN}}{(\text{MM})}$

TAPE SIZE	W	F	E	Po	Pz	D	Tmax	Kmax	P	Ao,Bo
8 mm	.315±.008 (8.0±0.2)	.138±.002 (3.5±0.5)	.069±.002 (1.75±.05)	.157±.004 (4.0±0.1)	.079±.002 (2.0±.05)	$.059^{+.0004}_{-.0000}$ $(1.5^{+0.1}_{-0.0})$	.012 (0.3)	.079 (2.0)	.157±.004 (4.0±0.1)	*
12 mm	.472±.008 (12±0.2)	.217±.002 (5.5±0.5)	.069±.002 (1.75±.05)	.157±.004 (4.0±0.1)	.079±.002 (2.0±.05)	$.059^{+.0004}_{-.0000}$ $(1.5^{+0.1}_{-0.0})$	.012 (0.3)	.177 (4.5)	.315±.004 (8.0±0.1)	*

*Ao, Bo ARE DETERMINED BY COMPONENT SIZE

REEL DIMENSIONS $\frac{\text{IN}}{(\text{MM})}$

TAPE SIZE	Bmin	C	A 7 inch	A 13 inch	Dmin	Nmin	G	Tmax
8 mm	.079 (2.0)	.512±.02 (13±.05)	7±.079 (178±2.0)	13±.008 (330±0.2)	.795 (20.2)	1.97 (50)	.394±.059 (10±1.5)	.587 (14.9)
12 mm	.079 (2.0)	.512±.02 (13±.05)	7±.079 (178±2.0)	13±.008 (330±0.2)	.795 (20.2)	1.97 (50)	.394±.059 (10±1.5)	.587 (14.9)

Philips Components also offers the following product catalogs:

■ **1990-1991 Leaded Resistor/Capacitor Data Book.** This catalog contains descriptive product and technical data on aluminum electrolytic capacitors, tantalum and ceramic capacitors, film and variable capacitors, fixed resistors, trimmers and non-linear resistors.

■ **Discrete Semiconductor Condensed Catalog.** This catalog contains information for all Philips Components discrete semiconductors including surface mount devices, power and small signal devices, optoelectronic devices and CATV and RF Power Modules.

■ **Ferrite Materials and Components Catalog.** This catalog contains one of the most complete and most diversified ranges of ferrite-based devices offered to the electronic industry including: Ferrite Materials; Pot Cores; Square Cores; Toroid Cores; E,U, and I Cores; EC Cores and ETD Cores; EP Cores; and Shielding Beads, Chokes, Rods and Tubes.

For your personal copy of any of the above catalogs, write to Philips Components, Marketing Communications Department, 2001 W. Blue Heron Blvd., Riviera Beach, Florida 33404 or call (800) 447-3762 or (407) 881-3200.

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